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GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Twenty-Second Annual Meeting, American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY, PROVIDENCE, R. I., Sept. 8, 1894.

Extract from the Constitution.

Sec. 12. Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least 10 days prior to the meeting at which the application is acted on.

GENERAL ANNOUNCEMENT.

The 22d annual meeting of the American Gas Light Association will be held at Washington, D. C., October 17, 18 and 19, 1894.

The meeting will be called to order by the President, W. H. Pearson, of Toronto, Canada, at 10 o'clock, A.M., on October 17, in Builders' Exchange Hall, on 13th street, between G and H streets. This is 3½ blocks from the headquarters, the Arlington Hotel, which is located on the corner of H street and Vermont avenue, one block from the White House. The Arlington is conveniently reached by the principal street car lines, as are the other first-class hotels in its vicinity.

As the most satisfactory quarters are always obtained by writing in advance to the hotel people, the following list of hotels is appended, and it is particularly suggested that in writing to them a reply be requested, for which a self-addressed and stamped envelope should be inclosed, as misunderstandings and disappointments may thereby be averted. Remember, "First come, first served."

Hotel.	Rate per Day.	Distance from Hall.	Remarks.
Arlington.....	$4 to $5	3½ blocks.	This is headquarters.
Riggs House....	$3 to $5	2 "	Located at 15th and G streets.
Willard's	$3.50 to $4.50	3½ "	Located at 14th street and Penn ave.
Ebbitt House...	$4	2½ "	Located at 14th and F streets.
Wormley's.....	$3	2½ "	Located at 15th and H streets.
Normandie.....	1 in room, $4.50 2 " 3.50 3 " 3.00	4 "	Located at 15th and I streets. Can take 100 persons.
Shoreham.....	$4	2½ "	Located at 15th and H streets. Can take 125 to 150.
Hamilton House	$2.50 up	4 "	Located at 14th and K streets.
National.....	$4	10 "	Located at Penna. av. and 6th st. Cars go within 3 blocks of hall.
Metropolitan....	$2.50	10 "	Penna. ave., close to National Hotel.
Howard House.	$2.50	10 "	Penna. ave., close to National Hotel.

All of the above hotels are conducted on the American plan, and can take from 25 to 50, except the Normandie and Shoreham (see "Remarks," above). The rates named by the Arlington, Riggs, Willard's and Normandie are special for this convention.

Reduced rates for transportation are being arranged for and undoubt-

edly will be secured. The final arrangements will be fully explained in a later circular of detailed information.

The roll call will be made by means of the door card method as usual, and be in charge of one of the Committee of Arrangements. Each member or visitor upon entering the hall for the first time will at the door receive a special card upon which to write his name, address, etc., the card then to be given to the doorkeeper.

The list of papers to be read at the meeting is not given herewith, as some of them are still in question, or titles not definitely settled; but the members are particularly requested to carefully read every page of the July and October "Quarterly," and come to the meeting prepared to discuss the articles therein presented, as the papers will be distributed in that form only. A complete list of the papers will be given later in the circular of detailed information.

Each member is expected to send in not only papers on original subjects, but also written discussions or analyses of any or all of the papers written by others, such written discussions to appear in the next issue of the "Quarterly."

The Question Box will be be made a special department of the "Quarterly," provided the members will support it by sending in responses to queries, as well as to keep the Box full of questions, which will be printed in each issue with the responses to the queries of the previous issue. Send in your questions as early as possible; *now*, if you can.

The Committee of Arrangements are completing the details of their programme, which will be reported later in another circular above referred to. The Secretary, however, is allowed to hint that the members will not be obliged to "kill time" for want of entertainment. The ladies will also be well cared for as usual.

Agreeably to the ancient custom of the Association, it is proposed to hold the traditional banquet on the evening of Thursday, Oct. 18, and in continuation of the precedent established last year, each one will pay for his own ticket. In order that the Committee may have some reliable data upon which to base their arrangements, will you please *immediately* fill out and mail the inclosed card to the Secretary, as this is very important, that the data therein asked for should be in his hands as soon as possible, *whether you expect to attend the meeting or not*. The Committee cannot complete their work without it.

During the days of the meeting bulletin boards will be placed in the lobbies of the Headquarters and the Meeting Hall. All members are warned to take due notice thereof and govern themselves accordingly, that they may be apprised of any change in or addition to the programme

Many of the members have allowed their dues to remain yet unpaid, and this is a source of much difficulty to the Treasurer and extra work and worriment to the Secretary, who has already sent several statements to each of the delinquent ones, as you must know, if you are one of them, unless you have failed to notify him of change of address.

The present addresses of the following-named members are unknown to the Secretary, who will be glad to receive any information concerning them: Joseph L. Hallett, E. H. B. Twining, Ed. R. Conant, Robert N. Sumner, W. I Wilson.

Don't forget that postal card to return. A. B. Slater, Jr., Sec.

Extract from the Constitution.

51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the Proceedings.

52. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Council.

BRIEFLY TOLD.

Outlook for the Washington Meeting.—Secretary Slater has nothing in particular just yet to add to his initial notice respecting the coming meeting of the American Association, not that he and his official colleagues are not proceeding satisfactorily with the work which remains to be completed in connection with the convention. The paper list, we understand, has grown in point of numbers, and promises much in the way of novelty of topics, which goes to show that when gas men put on their thinking caps they can easily, or without undue stress at any rate, discover some point on which to write that has not been thoroughly threshed, but that also possesses the characteristics of the kernel newly stripped from the husk. This state of things is especially creditable when one remembers the great increase of recent years in the number of our active gas associations, and we submit it plainly shows that the gas makers keep pace with the procession in the instance of their advancing capacity for close observation and subsequent analytical recounting of that which happens in their routine of work. While on this phase of the subject, it would be well to remind contributors again that, as the papers will only be given publicity for the purposes of the meeting in the Association's *Quarterly* (the last available issue of which will appear at as early a date as possible in October), the sooner the manuscript is in the Secretary's hands the easier it will be for him and the better it will be for themselves. A number of applications for membership have been made, which is indubitable evidence that the Association has not lost its attractiveness as a teacher for those who from one cause or another have heretofore failed to attend its classes. Meanwhile any who propose to join the active ranks, but who have not yet made formal application, should be prompt in communicating their intentions to the Secretary, since such applications must be made to him not less than ten days preceding the meeting. It might fairly be claimed that we would not be justified in suggesting the necessity of securing accommodations well in advance, since it is presumed that all gas men know perfectly how to fortify their comfort when travelling; but still we will venture the remark that now is the time to engage comfortable quarters. Many applications have been forwarded, and it looks that the Arlington will not have "rooms for hire" on demand during the meeting. The matter of securing reduced transportation rates has been virtually accomplished.

The City Council of St. Paul, Minn., and Col. Pugh's Opposition Project.—In our correspondence columns for this week will be found a communication from "C. A. W.," of St. Paul, Minn., who furnishes a very accurate summary of the recent agitation at that place regarding the project to there establish an opposition gas plant. Our correspondent also supplies a copy of the report finally rendered on the application of the oppositionists by the Committee of the City Council to whom the application had been referred. To say the least, the report of the Committee is surprising, in that the examiners, after several lengthy sessions, in which every latitude was allowed the petitioners, and during which much irrelevant matter was gone over, with perfect unanimity declared that the proposition submitted by Col. Pugh and his associates—by the way, there was then and there is now much doubt as to who the Colonel's associates were and are—was not for the best interest, either of the city of St. Paul or of its gas consumers. It is true that the few who testified in favor of the movement may seek comfort in the suggestion, contained in the 10th clause of the Committee's report, that on January 1, 1897, the city may purchase the entire plant of the St. Paul Gas Company at an appraised valuation; but cold comfort it certainly must prove, for should the city elect to foreclose its right, Col. Pugh and his people would still be on the outside. Again, while mentioning the thing that may afford them the cold comfort, we imagine they can extract more of the same sort of consolation from the 6th clause of the report, which states: "There appears to be no general dissatisfaction among our people with the present conduct of the business of the St. Paul Gas Light Company. That Company has recently made large reductions in its prices, which affect about 90 per cent. of the gas consumers of the city, and promises to make further reductions if those made result in even approximately proportional increases in consumption. It is worthy of notice that no citizens, or committees representing citizens, appeared before your Committee to urge the passage of the proposed ordinance." All of which goes to prove that the "citizens" who were most deeply interested were Col. Pugh and his associate speculators—always providing that the Colonel had associates. The Committee, too, it will be noticed, tacitly concedes the validity of the exclusive feature of the St. Paul Company's charter, which is a queer mark of fairness in a municipal body in these days of loud advocacy of paternal government. The report is not only unique in its showing of fair treatment for a Gas Company, but is remarkable for the candor of its expressions.

"Pray's Steam Tables and Engine Constants."—This is the title of a handsome volume recently compiled by Mr. Thomas Pray, Jr., of Boston, who has done his work well. While the author does not claim to have discovered anything new in the principles of his subjects, he should be credited with having arranged the computations in a style that is new—to us at any rate. As a means of facilitating calculations upon indicator diagrams, and the various problems connected with the operation of the steam engine the book will be an undoubted aid, and it is also worthy of note that every table in its pages was computed, and not copied by Mr. Pray. Steam users will appreciate at a glance through its pages the thorough style in which the author has mastered the laws which he expounds. The publishers are the D. Van Nostrand Company, of this city.

Notes.—The utterly inexcusable strike which prevailed in the collieries of the New York and Cleveland Gas Coal Company terminated in the complete defeat of the strikers, who have renounced their organization and resumed work on the terms originally proposed by the Company.——We regret to report the death of Mr. Van Leer Eastland, Superintendent of the Oakland (Cal.) Gas Light and Heat Company, whose demise occurred on the 8th inst.——It is likely that the gas works at Selma, Cal., will again be started up.

[Prepared for the JOURNAL.]

The Incandescent Electric Lamp.

By MR. WILLIAM E. MCKAY.

When we have made illuminating gas, either coal or water gas, the product can be drawn from the holder through an orifice of any shape or style, and if the initial jet is ignited a steady stream of light is furnished. There are scores of gas burners, jets and tips, but the use of these only economizes or enhances the value of the gas as an illuminant; the real potential of the flame was created when the gas was made.

The electric current, however, is not independent of the burner, when its transformation into light is desired. In incandescent electric lighting the modern form of commercial lamp is an indispensable factor. It is quite an easy task to produce the current, but before a practicable lamp was devised, many years of preliminary laboratory experiments were recorded. Therefore, the so-called "electric lighting companies" are only in part rightly named; the unknown maker of the lamps is the silent partner in the execution of their work.

Much (but not all) honor to Edison, whose tireless patience and skilful investigations pointed the way to the successful lamp! By the patents of 1879, a careful endeavor was made to monopolize all the possibilities of manufacture of incandescent lamps, but invention was so stimulated by the hope of gain that, in December, 1891, 23 forms of lamps were being made by as many independent concerns. Then came the decision of Judge Wallace, and injunction followed injunction, until nearly all makers were driven from the field, leaving the Edison Company a clear way. Owing to the operation of the act to relieve the United States Supreme Court, the court decisions in the several circuits of the United States were not uniform, nor even similar. In the West the anti-monopolistic sentiment was reflected in the decision handed down by Judge Halleck (from Denver, Col.). This judge decided against Edison, and refused to issue the injunction asked for as against local manufacturers. The rival company, thus protected, was at liberty to enter any part of the United States for the sale of its lamps, whereas the many other companies, enjoined elsewhere, under oth r judicial authorities, were prevented from making or selling anywhere. While the injustice thus wrought is being argued and re-argued, the Edison patents are reaching a hale, old age, with the promise of death in 1896 and 1897. The phenomenal increase in the use of incandescent lamps is shown in the following tables:

The Central Station.			*The Isolated Plant.*		
Year.	Stations.	Lamps.	Year.	Plants.	Lamps.
1882	1	90	1882	31	6,605
1883	4	24,930	1883	133	43,051
1884	15	45,126	1884	239	78,934
1885	25	58,914	1885	338	114,773
1886	45	103,032	1886	492	187,691
1887	110	256,853	1887	714	281,129
1888	232	424,227	1888	1,020	415,787
1889	348	589,979	1889	1,335	515,583
1890	572	895,193	1890	1,892	697,002
1891	835	1,304,215	1891	2,438	909,063
1892	1,066	1,818,933	1892	3,086	1,214,180
1893	1,277	2,500,000	1893	3,548	1,443,288

To make such quantities of lamps, the Edison laboratory is now replaced by the lamp works at Harrison, N. J., with a floor space of 160,000 square feet, with 24 buildings, and with more than a thousand employees. Here upwards of 20,000 lamps per day can be produced.

Such a profitable field was not to be worked without abundance of litigation, and beginning with 1884, when the German Patent Court declared Edison's patent fundamental, down to October, 1892, when the United States Circuit Court of Appeals confirmed Judge Wallace's decision declaring Edison the sole inventor of the incandescent lamp, between these dates there is a series of favorable decisions from the courts of several countries. But the ineradicable competition had the usual effect upon the price of the commodity. From selling 16-candle power lamps at 85 cents, the Edison price fell successively through 60, 40, 32, and down to 26 cents, or lower. And even now, when rivalry is sleeping, the price cannot be raised, for new methods, new means, new lamps have come to the fore, economy in production is the incessant endeavor. Despite the improvements in manufacture noticeable in the Harrison works, methods yet cheaper remain beyond the control of the former monopoly.

"In no branch of electrical work does the personal element figure for so potent an item as in the making of incandescent lamps. From theory to theory must be bridged by laboratory knowledge; the facts best known are those which have been self-learned, and a natural aptitude for scientific experiment and for practical deduction gives to the young electrical engineer exceptional advantages in this branch of work." In nearly these words, the class of electrical engineers last graduated from the Massachusetts Institute of Technology were addressed by Mr. E. E. Carey, to whom I am indebted for the explanation of the apparatus described below.

From all the assaults upon Edison's patent, only the second claim survived; this was for an all-glass receiver from which the air had been exhausted, with the electrical conductors passing through the glass, and connecting with a high resistance filament. The beautiful ingenuity with which Edison cast aside all attempts to cork up the lamp bulb, and sealed the glass with the glass itself, was a bright flash of genius. Slow, plodding work has now discovered that silk is a better filament than Edison's bamboo, and in describing the lamp thus fitted, the general *modus operandi* could be applied to a lamp of nearly any form of construction, whether glass-sealed or not. Of these silk threaded lamps, about 4,000 per day are being made, rather better, and somewhat cheaper, than the lamps fitted with bamboo filaments.

The silk used is specially prepared, raw or undyed. The size varies from 750 yards per ounce (used for 16-candle power lamps) to 55 yards per ounce (used for 300-candle power). The 300-candle power lamp bulb is about 10 inches by 6½ inches, and is fitted with a double filament of the heaviest silk. From the unrolling of the raw silk off the spools, to the shipping of the completed lamp, includes 28 handlings, all of them delicate, and each of them of such importance that a single mis-handling throws the lamp to scrap. The silk is first dipped in a chemical solution; by this, carbon is added to the thread, and its size is much reduced. Thus saturated, the silk, by winding and unwinding, is transferred from bobbin to bobbin; in its travel it passes between layers of fine tissue or absorbent papers, which remove any excess of chemicals. The silk is finally wound upon an oblong or elliptical bobbin made of charcoal; the turns are cut and secured by other threads, and the silk is ready for baking. The chemical treatment has not changed the flexibility of the silk, but the heating now does, and every provision is made for the easy manipulation of the fragile threads. The final length of a 16-candle power filament is about 7 inches, diameter, .005 inch, and each charcoal bobbin has about 200 filaments wound upon it. Half of this number are lost or broken before they can be used, so difficult is it to preserve the thread intact. About seven bobbins are packed in a selected crucible (No. 60) and 300 pounds of Connellsville coke raise the whole to a white heat during 12 or 13 hours. Any variation of the heat, or any inequality in its distribution, will spoil all the silk thus treated. To secure uniformity of heating, a furnace with a special flue is used. When withdrawn from this furnace, the ends of the filaments have shortened by an inch; the diameter has decreased 25 per cent., and the silk is of a dense, smooth black, with a roughened surface. From this point onwards, each filament is separately handled and treated.

The next step is the flash treatment with 90° gasoline. A rubber disc *R*, has arms *A*, making electrical contact in a circuit. The disc forms a removable cover to the glass reservoir *V*, which has glass pipe connections with the air *T*, a pump *P*, and the gasoline reservoir *G*. The mercurial column in the manometer *M*, indicates the pressure of the gas or air in the reservoir *V*. The operation is as follows: The air pipe *T*, to glass vessel *V*, being open, the cover *R* is removed, the ends of the filament to be tested are inserted and secured so that the filament will become part of the circuit. The cover *R* is replaced on the jar *V*, *T* is closed, pipe *P* to pump is opened and the jar is exhausted until the manometer *M* shows about ½ inch. Then *P* is closed, and pipe *G* to gasoline is opened, the vapor rushes into vessel *V*, showing a pressure on *M* of ½ inch to 1 inch, *G* is closed, and the current is turned through the filament. It glows brilliantly; so bright is the light that a plate of blue or purple glass is fastened in front of the jar *V* to screen the operator's eyes. An electrical balance *C* has one arm drawn down by the current passing through the filament, so that the exposure of each thread is equal, the current being shut off by the lowering of the arm of the balance. The effect of this vapor bath is to change the filament from a black to a steel-gray color, and the surface is smoother, being hardened and filled with close, dense particles of carbon abstracted from the gasoline vapor. So dexterous are the workwomen, that one woman can treat 1,200 to 1,600 filaments in 8 hours, on a duplex apparatus.

The ends of the filament are now inserted in small tin-coated iron wires, hollowed to receive them; the joint is cemented and the filament is ready for a bath in 72° naphtha. Sliding brass jaws grasp the filament ½ of an inch from the joint with the iron wires, and as the revolving rubber shutter lowers into the naphtha, a brass clamp is drawn against the iron wires an equal distance from the joint. The brasses are

Figure 1

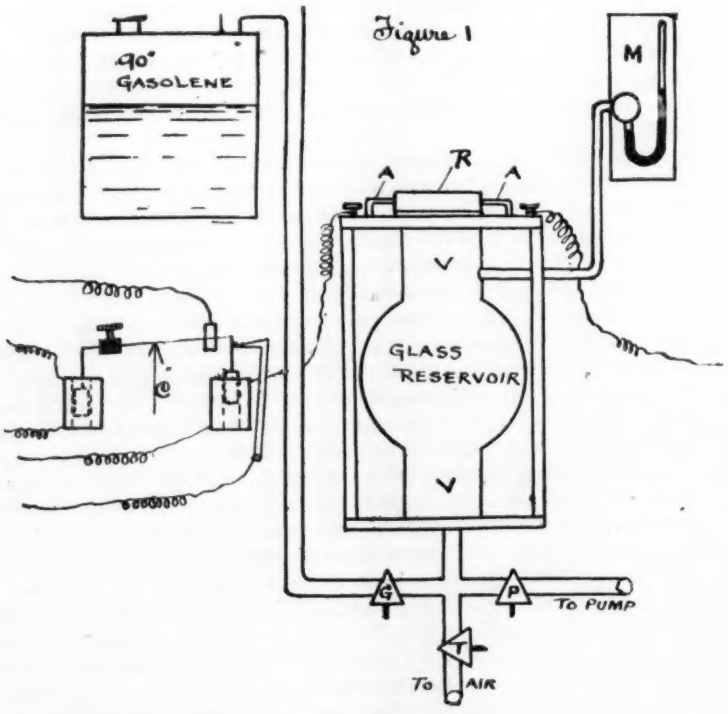


Figure 2

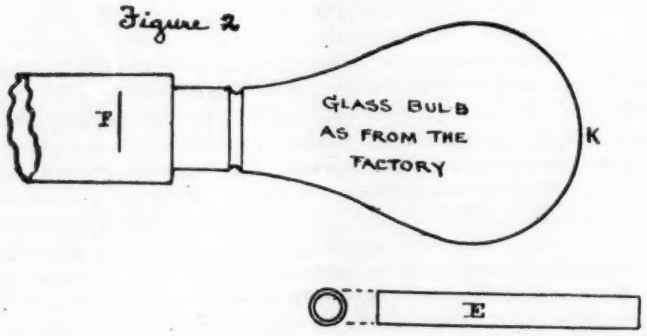
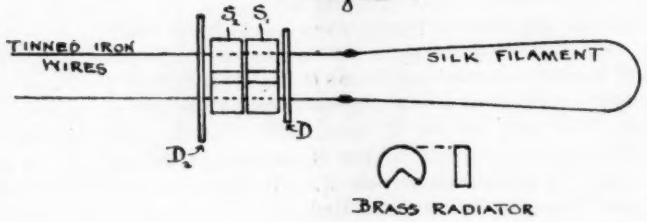


Figure 3



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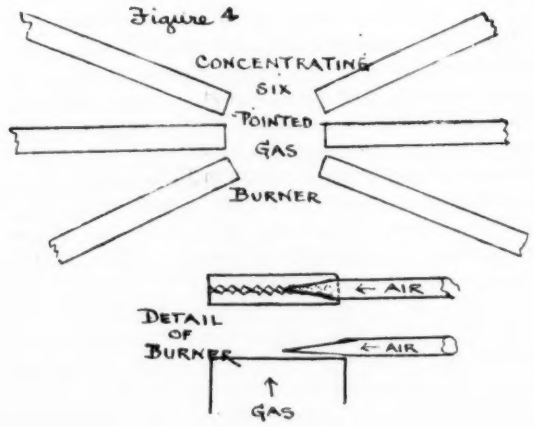
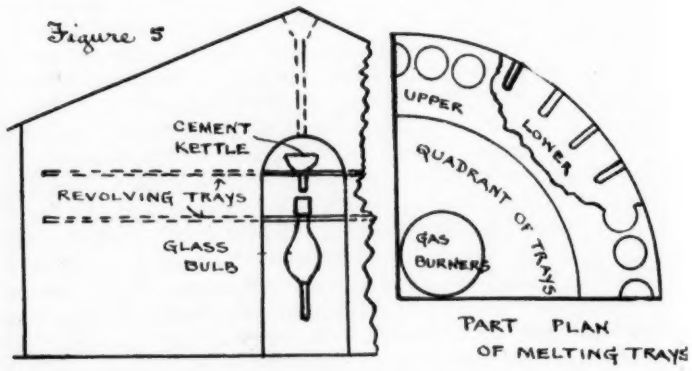


Figure 5



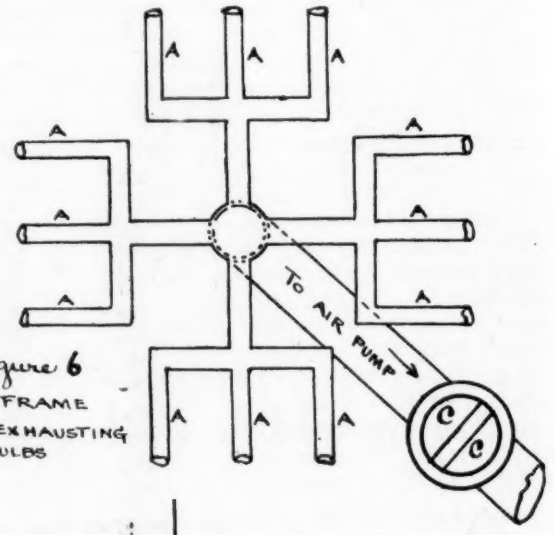


Figure 6

BED FRAME FOR EXHAUSTING BULBS

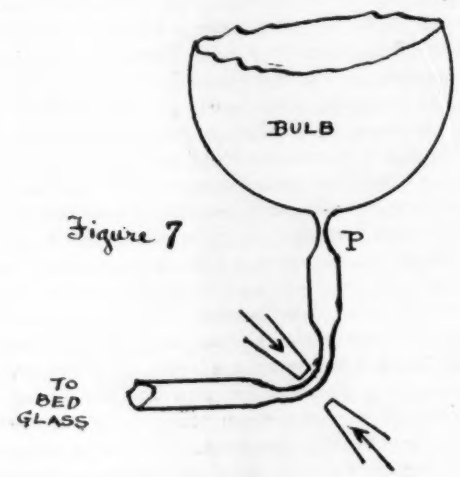


Figure 7

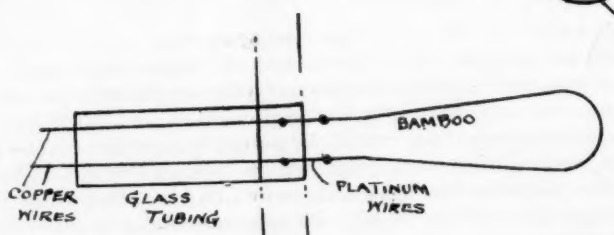
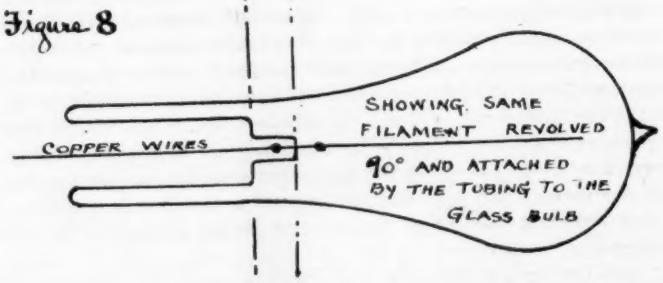


Figure 8



electrically connected, the current passes, and there is enough sputtering, flame, noise and smoke in the neighborhood of the naphtha tank to cause a gas man grave fears. When the filament is removed, the joints with the wires are seen to be perfectly fused. One operator cements 1,000 filaments per diem, or bathes 800 filaments in the naphtha. The filament is now ready to be put into the glass bulb.

These bulbs are of glass, of the grade next to cut glass; though thin they are strong. They are of lead glass, from Toledo, Ohio. The breakage of bulbs from handling averages 10 per cent. When received at the lamp works the bulb has the shape shown in Fig. 2. After marking the open neck at *F*, to show where the finished neck is to be capped, the first thing done with the new bulb is to break it. A small glass tube is placed in contact with the bulb at *K*, and heated in the gas flame (*K* is always the center of the tip of the bulb). The tube is then quickly pulled away from the bulb and broken off; a slight puff of air blown into the bulb blows out a neat small hole, a little less in diameter than the tube *E*. Tube *E* is now again connected with the bulb at *K*, the edges of the tube encircling the hole just blown into the bulb. *E* is slightly elongated and then left to cool. As will be seen later, the purpose of the tube *E*, thus attached to the bulb, is to permit of the final exhaustion of the air from the lamp. The neck of the bulb is now cut off at *F*, by laying it on a hollowed iron rack, knife-edged, and heated; when removed the neck is cleanly broken by a twist of the wrist.

The bulb is now ready to receive the filament, which is first fitted with mica reflectors, and with radiators made of glass or of brass, but neither reflectors nor radiators are actual integral parts of the circuit, but merely mechanical attachments to the filament, or to its wire connections. The filament, as fitted with the mica discs and the radiators, is shown in Fig. 3. When the finished lamp is in service, of the whole heat radiated from the luminous filament, a considerable portion converges towards the neck of the bulb; the glass sides and ends of the bulb add by reflection to the heat thus received. The mica disc D_1 reflects, in turn, much of the heat falling upon its surface. Of the heat carried beyond D_1 nearly all is absorbed by and subsequently radiated from the radiators of glass or brass *S*, and the second disc D_2 is inserted as a reflector for the minute quantity of heat that may ultimately reach it; D_2 also serves as the bottom of the tray formed by the walls of the glass neck to receive the sealing cement. The filament wires pass easily through fine holes punctured in the mica discs, and the radiators, if of brass, are attached by a vise machine, the brass before being gripped to the wire being of the form shown in the sketch. To attach glass radiators, short cylinders of glass, $\frac{1}{4}$ inch by $\frac{1}{8}$ inch, are laid transversely upon the wires; the glass is heated by a gas flame which melts the wires half way into the glass cylinders; then a pedal mould is brought down to position, literally casting the softened glass evenly about the wires. This whole operation, so long to describe, is executed with such celerity that one workman can fit up 1,600 to 2,000 radiators in one working day. The favorite form of gas flame for heating, in lamp work, is the six-pointed converging flame, illustrated in Fig. 4; one valve motion turns on both air blast and gas, and renders possible quick changes of pressure and temperature.

The filament is now put into the bulb, and a small iron pin, secured by a brass clamped to the neck of the bulb, holds the mica disc D_2 hard down to the glass seat. The cement seal is now run in. For this operation the bulb is placed in a circular wooden tray, holding in all 40 bulbs around its periphery. This tray is covered by another tray, holding 40 little glass kettles, into which the cement is placed as a carefully weighed, brown and broken cake. Both trays revolve about a stand in the center, and the whole apparatus is hooded and walled in so that it looks like a miniature guard house. A special Bunsen burner below the lowest tray furnishes the heat required for melting the cement, and light for the interior of the holder is given by an incandescent lamp. A small door gives the operator access, and as one bulb is removed another takes its place. Each bulb remains in place about 20 minutes, and as the trays revolve the cement in the glass kettle melts and falls, drop by drop, through a funnel opening in the bottom of the kettle, into the neck of the lamp bulb below. The weighed charge of cement exactly fills the neck of the bulb, and the lamp, when it leaves this tray, is tightly sealed. This fusible cement is a solvent of gum, and its preparation is one of the shop secrets. The early use of this seal was not successful, but at present it is as tight as the glass seal, much cheaper, and the durability is far in excess of that of the fragile glass seal. A general idea of the process of sealing is given in Fig. 5. The brass clamp on the neck of the glass is now removed, the iron strut pin is filed off and plastered over, and the bulb is ready for exhaustion.

The lamps are arranged in beds of 12, and from 20 to 40 beds are exhausted at one operation. To bed the bulbs a strong frame of glass tubing is used; this has the shape shown in Fig. 6. A ground glass cock *C* controls the main tube to the bed, and to each of the 12 arms *A* a bulb is attached by the glass blower. The tube at the end of the bulb is heated, drawn, bent and fastened in the manner indicated in the sketch, so that when the lamp is afterwards removed the bed glass remains intact and ready to receive a fresh dozen of bulbs. With 12 bulbs secured to the bed, the main glass tube is cemented to the exhaust pump connection. To the filament wires of each bulb electric wire connections are so made that each lamp is in readiness for use, and when the pump is started the current is turned through the lamps. The pressure or voltage is much higher than the lamp is ever to endure in commercial use; this high pressure is to drive from the silk filament all occluded gases and to insure the density and hardness of the filament. The pumping apparatus is a special feature of this process. The pistons have the metallic packing rings, and all parts of the pump are metallic. No glass or mercury is used, and it is the only pump dispensing with these aids which can completely exhaust the lamp b lbs. The principle upon which the pump efficiency depends is in the fact that de-aerated oil has a great absorptive appetite for air and for gases generally. Just after the valves close, and before the piston reaches the limit of the compression space or clearance, a charge of de-aerated oil is forced through this space, cleaning it out quite clear of all gas or vapor, so that the return stroke of the piston creates a remarkable suction. The oil thus charged is itself next treated, the air being actually pumped out of the oil in turn. This alternating process continues indefinitely. Several kinds of oil can be used, mineral or other; the oil now in use has been worked without loss for over two years. In the Edison factories two hours' pumping is required to obtain the best vacuum. With this oil pump a better vacuum is obtained after 20 minutes' pumping. The time of pumping is first determined experimentally, and is then known for lamps of stated current and candle power. With the pumps still running the lamps are removed one by one, a gas flame being directed as shown in Fig. 7, so that the lamp opening and the pump pipe opening are simultaneously closed as the glass melts and collapses. The glass tube tip *P* is afterwards again melted off, sealing the lamp bulb with usual little tear-drop close to the bulb. Two boys and a man will exhaust 2,500 lamps in 8 hours.

The lamps (as they can now be justly called) are then tested in a dark room, with a Ruhmkorff coil, for Crooke's effects. Crooke's tubes and Nikola Tesla's experiments have familiarized us with the beautiful colors shown by highly attenuated gases, when under stress from the passage of an electric current. In the present instance, if the lamp glows like a white, thin, silvery mist, it is accepted; but if it displays a purple or amethystine hue, nitrogen is known to be contained in the lamp, and the bulb is rebedded and again exhausted. This test is a signal instance of the successful commercial application of a highly scientific and sensitive experiment.

If the lamp passes the previous test, it is now tested in the photometer room. Two elements factor the candle power; these are the voltage and the size of the filament. As the diameters of the silk filaments best suited for the different candle powers have been determined experimentally, the lamp is graded for candle power when it arrives at the photometer room, and the real object of the test is to determine what current is required to produce, in the la.. p, the candle power for which it is built. Gas burning behind a Methven screen gives the standard. The screen is adjusted so that two candles balance it upon a bar test. The glass slide is moved along the bar until it reads 8.6 candles, if 16-candle power lamps are being tested. Then the lamp to be tested is elevated at the other end of the bar, and a current turned through it. Seated before the mirrors, the operator (usually a woman) has two current regulators, one on either hand; one is a coarse or approximate regulator, the other a fine one. With these she adjusts the current passing through the lamp so that the lights are balanced, as indicated in the bar reflectors. Reading off the current shown on the apparatus before her, the operator's assistant marks the reading in pencil upon a paper pasted on the bulb, and another lamp is tested. The assistant handles the lamps in sets of four, secured to a portable tree, and an automatic connection facilitates the operation so that presenting one side of the tree to the photometer throws one lamp into the circuit, and the other three lamps out. Two workmen will thus test 2,000 lamps per day. As noted above, for a 16-candle power lamp, $17\frac{1}{2}$ candles are actually given, and a similar excess is maintained on all grades of lamps.

The lamp is next fitted with the brass (wire) connection. These connections are cemented to the neck of the bulb with plaster of paris. There are many different styles of connection, as the Sawyer-Mann, the Thomson-Houston, the Edison, or any one of a dozen others. One girl can cement 1,500 a day. There is a difference in the labor for different

styles of connection, causing a variation in the value of the work of from 7 to 12 cents per hundred lamps. The lamps are next washed, dried and polished, and wrapped in tissue paper, then distributed for storage in assorted bins. For shipment, they are packed in sawdust, in numbers from 6 in a box to 200 in a barrel. More than a hundred different kinds of lamps are required by the trade, every variation of current and of candle power calling for the manufacture of a "special line of goods." With an output of 4,000 lamps per day, 140 persons find employment at the lamp works; a large majority of these workers are women. This is an average output of 30 lamps per person, while under the Edison manufacture the output is only 20 lamps per person per diem.

When the Edison system of closure is employed, the bamboo filament is cemented to the ends of two fine platinum wires; these, in turn, are connected with copper wires which are ultimately soldered to the brass wire-connection. Glass tubing is melted over the platinum portion of the wires, and when soft, the glass is pinched together so that the platinum wires are imbedded in solid glass. Then the upper ends of the walls of the tube (which encircles the copper conducting wires) are secured to the circular wall of the opening in the lamp bulb, as shown in Fig. 8. But the loss of bulbs from breaks and cracks is very large, throwing the cost of manufacture quite high. The bamboo filament of the Edison lamp is not nearly so hard, nor so dense, as the silk filament. This is the reason the Edison bulbs blacken in service, causing a double diminution of candle power—from deterioration of the filament, and from obstructing the transmission of the light. The silk filament will average 25 per cent. longer life than bamboo. But it is the variations of current that, more than anything else, destroy the lamps. As in gas distribution, so with electricity, steady pressure is economy of service. A uniform current will assure at least 1,200 hours at high grade work from each well made lamp.

In the course of an address recently delivered by Prof. Elihu Thomson, before the assembly of delegates from the Edison Electric Companies, this accomplished electrician stated as his opinion that the incandescent lamp would not be materially improved within many years. He saw no point at which a radical advance could be effected, and without implying that an immediate improvement of manufacture was impossible, he could not anticipate the direction from which advance could come.

Lamp makers lament their inability to secure a reasonable fraction of domestic gas burner tips to be fitted with incandescent lamps. The number of gas burners fitted ready for use is so enormous, in comparison with the number of electric lamps so placed, that the latter are wholly lost in the grand total of figures. Lamp makers are themselves dependent upon gas; just 1 cubic foot of gas is used in the making of one electric incandescent lamp.

The expiration of the Edison patents in England precipitated a selling contest. Lamps fell to 16 cents, at which price makers found no profit. The prices fell lower yet, to 12 cents, but then the actual loss was so heavy that a combination was effected, and the price was advanced to 25 cents per lamp, with dividends again in sight. In this country the labor cost of lamp making is lower than in England, but the total cost of materials is higher. We use machinery in manufacture to a degree unappreciated abroad. But the general prospect, as outlined by Prof. Thomson and by the manufacturers, does not include a great or quick reduction in the average cost of lamps to consumers.

Cost of Producing Electrical Energy.

In a communication by Mr. B. J. Arnold, to the Northwestern Electrical Association, in respect of the cost of producing electrical energy, the author said:

It was my intention when asked to prepare a paper upon this subject, to be read before this convention, to point out some of the principal sources of loss in the operation of the present central station, and afterward to assume an ideal plant, designed in accordance with the latest practice, and show at what price per kilowatt hour this station could deliver electrical energy to the consumer.

After the paper was partially prepared on this basis, Mr. R. E. Crompton read before the Institution of Electrical Engineers of London a paper covering practically this ground, in which he shows that with coal having a calorific value of 14,500 B. T. units, and with boilers capable of evaporating 12 pounds of water at a pressure of 150 pounds, and the losses so proportioned that 2½ pounds of this coal will evaporate 25 pounds of water, that a kilowatt hour can be produced for 3 cents and delivered to the customer for 6 cents, leaving a profit of 3 cents over and above all operating expenses and interest on the investment. He figures that an average of 20 pounds of steam per kilowatt hour is all that would be required for actual service.

Mr. Crompton's paper having covered practically the ground I had mapped out, has led me to abandon my original plan, in place of which I will present to you to-day the records of a number of central stations operating in this country and Europe, from which you can, by comparison, ascertain whether your stations are doing as good service as they should. I will endeavor also to suggest ways in which the earning capacity of stations now running can be increased.

The losses between indicated and electrical horse power in a fairly well designed high speed, belted, direct current station are about as follows: Engines 10 per cent, belts 4 per cent., dynamos 10 per cent., line 10 per cent., making a total commercial efficiency of 70 per cent.

In alternating direct belted plants the losses on engines, belts and dynamos are practically the same as given above. The losses in the primary circuit are usually 5 per cent. Where there are many small transformers and when working under loaded, as they usually are for a large portion of the time in small central stations, the average loss will be about 10 per cent., although when they are working at their rated load they will give an efficiency of 93 per cent. to 95 per cent. The loss on the secondary wiring is usually 2 per cent. Combining these losses we find the average commercial efficiency of the alternating plant to be 65 per cent. In stations operating large engines belted to a countershaft the losses are practically the same as given above, except that the loss between the power delivered by the engine and the power delivered to the generators is usually about 20 per cent., making the commercial or industrial efficiency of the above systems 58 per cent. and 52 per cent. respectively, although there are many cases on record in which the losses are far greater than these, caused by unsoldered joints in the line construction, or defectively designed and operated machinery.

Table No. 1, published recently in *L'Industrie Electrique*, was prepared by Mr. J. Laffargue. I have reproduced it here, as it contains the most complete information regarding foreign central stations that I have been able to secure. The stations are all located in Germany; two of them, those at Elberfeld and Hamburg, being direct current plants, the one at Cologne an alternating station, and those at Barmen, Hamburg and Dusseldorf direct current stations with accumulators as auxiliaries. The table enables us to compare the relative merits of the three systems, and as will be noticed, the alternating station at Cologne produces 71 watt hours per pound of coal, and delivers a kilowatt to the customer for 6.65 cents. The station at Hanover produces the greatst number of watts per pound of coal, namely, 219, and delivers a kilowatt hour to the consumer for 5.2 cents, while the best result of all is shown by the station at Dusseldorf, producing, as it does, 185 watt hours per pound of coal and furnishing a kilowatt to the consumer for 4.54 cents. This would seem to indicate that there is an advantage in using accumulators. It is also interesting to note that the average commercial efficiency of the accumulators is 76.1 per cent.

Mr. Laffargue adds that the following percentages are allowed for depreciation: 1½ to 2 per cent. on the buildings, 4 to 5 per cent. on the boilers and engines, and 6 per cent. on the accumulators; 3 per cent. on the mains and 8 to 10 per cent. on the various auxiliaries of the plant. These figures are about correct for practice in this country, except on the accumulator question, and as there are now numerous strong companies entering the field in this country, who are willing to guarantee to maintain battery plants for 10 per cent. per annum, it is possible that we can soon reach the state of perfection in the line that is indicated by these figures.

In comparing the figures on a basis of cost per kilowatt hour delivered to the consumer, the loss in the mains of the various stations should be taken into consideration, as it will be noticed that at Dusseldorf the loss between the station and the consumer is over 30 per cent., at Hanover 20 per cent., Barmen 15 per cent., while at Hamburg and Elberfeld it is but 5½ per cent. and 2½ per cent., respectively. Were these allowances made, it would probably bring the cost at Dusseldorf much below the present figure, but not knowing the exact conditions it was impossible to make the proper allowance in this paper.

The first part of Table No. 2, marked "Direct Current," was prepared from reliable information on file in the writer's office, and is the result of the operation of 15 large direct current stations located in different parts of the United States. The three succeeding parts of the table, marked "Direct Current," "Alternating Current," and "Combined Systems," have been compiled from information secured from the report of the committee on statistics of the National Electric Light Association, presented at its last meeting, and figures were chosen only from such stations as seemed to bear evidence of careful compilation. This

TABLE No. 1.

	Direct Current.		Direct Current with Accumulators.			Alternating.
	Elberfeld.	Hamburg.	Barmen.	Hanover.	Dusseldorf.	Cologne.
General Data.						
Fifty-watt lamps, capable of being supplied from the works	10,000	11,600	4,500	12,000	12,000	13,600
" " " " " mains	12,000	12,000	6,500	23,000	23,000	24,000
Available power in kilowatts	500	580	225	600	600	680
Expenses of First Establishment.						
Installation capital, in dollars	272,829.96	473,912.90	204,425.53	504,176.51	557,194.58	472,500.58
Specific expenditure, in dollars per kilowatt	545.53	816.93	908.50	785.70	926.35	693.55
" " " lamp	24.25	31.43	31.53	39.28	46.32	34.68
Receipts and Expenses.						
Duration of working, in years	5	4	5	2	1	1
Total receipts, in dollars	46,281.80	112,245.49	23,995.08	65,002.22	54,710.04	54,738,65
Receipts, per cent. of the capital	20.50	23.68	11.74	15.8	9.8	11.5
Total expenditure, in dollars	17,498.99	26,568.21	8,365.67	18,370.92	15,328.13	20,460.21
Expenditure, per cent. of the capital	6.41	5.62	4.9	4.46	2.72	4.07
Rough total profits, in dollars	28,782.81	85,677.28	15,629.43	46,621.30	39,381.91	34,278.44
Profits, per cent. of the capital	14.09	18.05	7.65	11.34	7	7.2
Expenses—Cost.						
Total energy in kilowatt hours, produced	313,438	542,900	114,996	452,520	484,111	
" " " " distributed	305,794	513,183	122,026	365,114	337,285	307,074
Efficiency of the mains, per cent.	97.5	94.5	84.16	80.69	69.68	
Energy in watt hours per pound coal, produced		148	104	219	185	
" " " " distributed		140	90	181	129	71
Salaries in cents per kilowatt hour, produced	2.44	1.80	3.28	1.73	1.63	
" " " " distributed	2.52	1.92	3.90	2.15	2.33	2.93
Cost per kilowatt hour in cents, produced	5.57	4.91	5.76	4.05	3.15	
" " " " distributed	5.70	5.18	6.85	5.02	4.54	6.65
Mean selling price in cents per kilowatt hour, including all expenses	18.29	21.86	19.65	17.79	16.20	17.81
Charge without deduction for the kilowatt hour, in cents	17.65		17.65	17.90	20.95	16.96
Price per cubic foot of gas, consumption above 3,000 cubic feet, cents	.11		.12	.105	.103	.081
Coefficients of Utilization—Duration of Lighting.						
Number of 50-watt lamps installed	11,100	14,000	7,325	13,642	16,623	15,329
Maximum power utilized in kilowatts	400	462	139	415	309	325
Ratio of power utilized to power available	0.80	0.79	0.61	0.48	0.51	0.50
Duration of lighting, in hours, per annum	569	693	325	529	419	422
Employment of Accumulators.						
Energy expended for the charge, in kilowatt hours			59,573	194,733	279,506	
Energy furnished by the discharge, in kilowatt hours			42,584	154,836	216,561	
Industrial efficiency of the accumulators, per cent.			71.5	79.4	77.5	
Ratio of energy supplied by the accumulators to the total energy distributed, per cent			35	42.3	62.	
Loss in the accumulators, per cent. of the total energy distributed			14	11	13.	

TABLE No. 2.

	Station	Horse Power Capacity.	Kilowatt Capacity.	Hours Operated per Day.	Watt Hours per Day.	Coal. Kind.	Coal. Cost per Ton.	Coal. Watt Hour per lb.	Cost per Kilow't Hour.	Cost Other Expenses per Kilow't Hour.	Total Cost per Kilow't H'r Delivered to Customers.
									Cents.	Cents.	Cents.
Direct Current.	1	.....	.....	.....	604,600	.....	$2.53	114	1.11	4.94	6.05
	2	.....	.....	.....	404,300	.....	3.01	88	1.10	4.06	5.76
	3	.....	.....	.....	305,300	.....	2.57	107	1.20	5.16	6.36
	4	.....	.....	.....	299,600	.....	2.47	122	1.01	4.72	5.73
	5	.....	.....	.....	194,150	.....	.....	.....	.....	.....	6.35
	6	.....	.....	.....	140,000	.....	2.55	108	1.18	5.76	6.94
	7	.....	.....	.....	126,700	.....	3.15	53	2.96	5.92	8.88
	8	.....	.....	.....	105,700	.....	1.94	71	1.36	3.37	4.73
	9	.....	.....	.....	85,100	.....	1.42	65	1.10	3.61	4.71
	10	.....	.....	.....	53,700	.....	2.20	53	2.06	3.05	5.11
	11	.....	.....	.....	50,300	.....	.82	48	.85	5.07	5.92
	12	.....	.....	.....	47,800	.....	.....	.....	2.24	4.69	6.93
	13	.....	.....	.....	37,100	.....	2.26	82	1.38	5.71	7.09
	14	.....	.....	.....	33,600	.....	2.38	66	1.80	4.42	6.22
	15	.....	.....	.....	33,400	.....	.....	.....	.11	.....	6.19
	Averages.						$2.28	81.5	1.46	4.65	6.20
Direct Current.	16	90	67,045	24	1,609,070	bitum. slack.	Asmd $1.50	150	.50	.....	.....
	17	25	18,400	15	276,000	" "	1.50	46	1.63	.....	.....
	18	37	27,450	10	274,500	" "	1.50	56	1.34	.....	.....
	19	17	12,720	14.7	187,860	" "	1.50	64	1.17	.....	.....
	20	18	13,420	6.5	87,230	" "	1.50	62	1.21	.....	.....
	21	20	14,560	5.0	72,800	" "	1.50	40	1.87	.....	.....
	22	48	35,650	7.5	267,375	" block.	3.00	76	1.98	.....	.....
	23	33	24,605	10	246,057	" "	3.00	46	3.27	.....	.....
	24	20	15,000	9	135,000	" "	3.00	56	2.68	.....	.....
	25	20	15,200	6	91,368	anthracite pea.	4.50	65	3.46	.....	.....
	Averages.							66	1.91		
Alternating Current.	26	26	19,000	8	152,000	bitum. slack.	$1.50	104	.72	.....	.....
	27	295	220,000	9.5	2,090,000	Indiana block.	3.00	52	2.89	.....	.....
	28	66	49,220	16.0	785,920	bitum. "	3.00	121	1.24	.....	.....
	29	38	28,000	12.0	336,000	" "	3.00	96	1.56	.....	.....
	30	30	22,000	11.0	242,000	" "	3.00	76	1.98	.....	.....
	31	30	22,300	14.0	312,666	anthracite pea.	4.50	108	2.09	.....	.....
	32	25	18,480	6.0	110,880	" "	4.50	110	2.05	.....	.....
	Averages.							95.3	1.79		
Combined Systems.	33	181	134,780	21.0	2,843,760	bitum. block.	$3.00	104	1.44	.....	.....
	34	446	332,150	24.0	7,971,600	anthr. ser'ings.	1.50	208	.36	.....	.....
	35	32	24,100	15.5	373,520	bitum. slack.	1.50	111	.68	.....	.....
	Averages.							141	.83		
German Plants.	Elbefeld (dir. cur. station)				313,438	.....	.....	.....	.....	.....	5.70
	Hamburg " "				542,900	.....	.....	148	.....	.....	5.18
	Cologne (alter. cur. ")				207,074	.....	.....	71	.....	.....	6.65
	Barmen (dir. cur. with ac.)				144,996	.....	.....	104	.....	.....	6.85
	Hanover " "				452,520	.....	.....	219	.....	.....	5.02
	Dusseldorf " "				484,111	.....	.....	185	.....	.....	4.54

TABLE No. 3.

Twenty-four Hour Test on Coal.	Average Gauge Pressure, Pounds.	Temperature.		Duration, Hours.	Average Watts.			Evaporation per Hour, Pounds.			Com. H.P. 34½ Lbs. Water, Hour, 213°.	Cost of Fuel for Period.	Total Cost of Operation, Including Labor.	Total Cost Fuel and Labor per Kilowatt Hour Produced.
		Feed Water.	Escaping Gases.		Railroad Circuit.	Incandescent Circuit.	Arc Circuit.	Actual Evaporation.	Factor Evaporation.	From and at 212°.				
		Degrees.	Degrees.											Cents.
Feb. 2.—10:20 A.M. to 4:10 P.M.	125	116	640	5.83	39,215	.....	.....	3,536	.....	4,052	117.5	$3.72	$7.11	3.10
4:10 P.M. to 5:45 P.M.	.....	128	680	1.58	34,100	34,650	9,180	4,433	.....	5,082	147.3	1.27	2.28	1.85
5:45 P.M. to 8:20 P.M.	.....	118	.....	2.58	41,360	38,940	24,140	6,522	.....	7,474	216.6	3.04	4.13	1.53
8:20 P.M. to 12:00 M. ..	.....	116	.....	3.66	26,620	27,170	24,140	5,735	.....	6,571	190.5	3.79	5.33	1.87
Feb. 3.—12:00 P.M. to 5:50 A.M.	.....	110	620	5.83	2,572	16,611	8,160	4,774	.....	5,471	158.6	5.03	6.26	3.96
5:50 A.M. to 7:10 A.M.	.....	116	.....	1.33	24,640	16,500	.....	3,409	.....	3,907	113.3	.82	1.40	2.52
7:10 A.M. to 10:20 A.M.	125	118	.....	3.16	40,480	.....	.....	4,559	.....	5,225	151.5	2.60	3.97	3.08
For entire run.....	125	114	635	24.00	.....	.....	.....	4,680	1.146	5,364	155.5	20.27	30.48	2.45

Twenty-four Hour Test on Oil.														
Feb. 6.—10:20 A.M. to 4:50 P.M.	125	126	480	6.50	29,631	.....	.....	3,677	.....	4,184	121.3	$4.98	$8.80	4.31
4:50 P.M. to 5:55 P.M.	.....	124	.....	1.08	32,436	35,420	9,180	4,565	.....	5,195	150.6	1.03	1.81	2.13
5:55 P.M. to 8:20 P.M.	.....	128	520	2.41	33,573	39,160	24,140	6,310	.....	7,180	208.1	3.18	4.19	1.58
8:20 P.M. to 12:00 M. ..	.....	.....	.....	3.66	24,192	27,170	24,140	5,282	.....	6,011	174.3	4.04	5.58	2.03
Feb. 7.—12:00 M. to 5:50 A.M.	.....	116	.....	5.83	660	16,500	9,180	4,096	.....	4,661	135.1	4.98	6.20	4.06
5:50 A.M. to 6:07 A.M.	.....	124	.....	.28	23,980	16,500	9,180	5,824	.....	6,627	192.1	.34	.40	2.50
6:07 A.M. to 10:20 A.M.	125	118	.....	4.21	33,920	.....	.....	3,551	.....	4,041	147.2	3.12	4.95	3.72
For entire run.....	125	122	.....	24.00	.....	.....	.....	4,332	1.138	4,930	142.9	21.67	31.93	2.83

For entire run : 24-hour test on coal. Total pounds of ash (11.02 per cent.), 1,719. Total combustible, pounds, 13,878. Evaporation per hour per pound of fuel : actual, 7.20 ; equivalent, 8.25.
Cost per commercial horse power per hour for fuel, $.00543.
For entire run : 24-hour test on oil. Cost of oil, per gallon, .017865 ; per pound, .00253. Evaporation per hour per pound of oil : actual, 12.13 ; equivalent, from and at 212°, 13.80. Cost per commercial horse power per hour for fuel, $.006324.

report did not give the cost of coal per ton nor the cost of coal per kilowatt hour, but simply gave the watt hours produced per pound of coal. By assuming a price per ton on the coal we have deduced the costs per kilowatt hour which are given, but not having the information necessary to ascertain the operating expenses or fixed charges, the total cost per kilowatt hour delivered to the consumer is omitted.

In general, however, I will state that the expense of operating in central lighting stations is approximately as follows :

Fuel	23.15 per cent.
Labor	21.20 "
Lamps	7.75 "
Repairs	13.10 "
General expenses	23.15 "
Other expenses	11.65 "
Total	100.00 "

The last portion of Table No. 2 is a synopsis of Table No. 1. Table No. 3 is the result of three tests made under the direction of the writer on a combined electric and lighting station, to ascertain the relative economy of oil and coal for fuel. Inasmuch as the information is quite complete it has been thought advisable to insert it in this paper. The station consists of two compound condensing engines, coupled direct to a line shaft. This shaft runs two 90-kilowatt railway generators, two 16-kilowatt arc light machines, two alternating incandescent dynamos of 30 and 50 kilowatt capacity respectively, or a total capacity of 392 kilowatts. The station is delivering but 1,248 kilowatt hours, showing that it is running considerably under loaded.

Referring to Table No. 3, it will be observed that the test began at 10:20 A.M. and continued for 24 hours. As the load in this station varied greatly, one of the objects of the test was to ascertain the cost of producing power during the different periods, and the right hand column in the table shows the total cost per kilowatt hour of the power thus produced.

The railway portion of this station operates from four to six cars, and during the time of the test but four cars were in operation. The cars started at 5.50 A.M. and ran until 12 o'clock midnight, and the lighting load was added as indicated by the figure.

The division in the table shows the principal variation in the load, and it is interesting to note the change in cost per kilowatt hour produced, depending, of course, as it does upon the quantity of current delivered, as the cost remains practically constant, with the exception of the fuel. From 7.20 A.M. to 4.10 P.M., when the railway load is being operated, the cost averages 3.1 cents per kilowatt hour, and from 12 o'clock midnight until 5 A.M. the cost per kilowatt hour is 3.96 cents, while during the heavy load, from 5 P.M. until midnight, the average cost per kilowatt hour is but 1.75 cents, and after deducting the labor, which is a fixed charge, the total cost per kilowatt hour for full load is but 1¼ cents. After allowing for salaries, office expenses, loss in lines and depreciation in the plant, the figures show that this station is delivering current to the consumer for 6.4 cents per kilowatt hour, which corresponds fairly well with the figures given in Table No. 2.

With a little calculation we see that this plant could have furnished 681 additional kilowatt hours, or over 90 additional horse power in motors, for 10 hours from 6 A.M. to 6 P.M., for an additional cost of but $9 for fuel, or at a cost of 1 cent per horse power hour, and as a price of 2 cents per horse power hour can be obtained for motor work, there would be an additional revenue of $9 per day added to this station, assuming that all the motors were running fully loaded.

As a matter of fact, the following statement shows approximately the average amount of power demanded from electric motors when running on various kinds of work : Wood working machinery, 40 per cent. of rated capacity of machines in the plant; elevators, 80 per cent.; printing presses, 55 per cent.; machine shops, 40 per cent., or an average of about 55 per cent. On this basis this plant could drive safely 160-horse power in addition to its present railroad load, which, at 2 cents per horse power hour, would bring an additional revenue of $33 per day, and deducting $9, the cost of fuel, leaves $24 per day additional net profit which this plant can be made to earn, provided the full capacity of the motors is paid for.

In case the additional load for electric motors is not available, this extra 90-horse power could be utilized in driving an ice plant. In practice it takes about 2-horse power 24 hours to produce a ton of ice, and on this basis the available capacity of this plant would produce 20 tons of ice, which would sell for at least $2 per ton, making an additional revenue of $60 per day for the plant, and after deducting for extra fuel, labor and depreciation, leaves $40 per day.

The cost of ice making plants is about as follows, per ton of output in 24 hours :

1 ton	$2,700
2 "	2,650
6 "	1,216
12 "	992
20 "	875
40 "	800

While the addition of an ice plant to an electric light plant may not be particularly desirable in stations throughout the Northwest, there is no doubt that there are many stations throughout the Southern and Western States where such plants could be installed to advantage.

In closing this paper I will briefly call attention to the approximate results we are now getting from the different portions of power stations, and what we ought to expect from stations designed in the future.

First.—Boilers. A large number of stations running now are using boilers with plain furnaces, from which they secure an evaporation of 5 pounds of water per pound of coal. By the introduction of water tube or internally fired boilers or tubular boilers set in improved furnaces, we will secure an evaporation of 8 pounds of water per pound of the same fuel.

Second.—Engine and Generators. While we now get an average commercial efficiency of 60 to 70 per cent. in direct belted plants and 50 to 60 per cent. in those using shafting, we can increase these efficiencies to 70 and 75 per cent. respectively by the adoption of fewer and larger direct coupled units. This will not only reduce the cost of fuel and labor but will decrease the amount of real estate required and make the total investment less.

Third.—While Europeans have recognized the advantage of the use of accumulators with batteries as auxiliaries in central station work, we have been slow to see this advantage ; but the tendency now among American engineers and central station men is to look with favor upon this adjunct, and as there are many cases wherein a battery plant as an auxiliary can be made to pay well, the probability is that we shall see in the next five years many such plants installed. With a properly designed direct connected plant we may reasonably expect to deliver a kilowatt hour to the consumer in stations having a capacity of not over 1,500 kilowatts for 5 cents per kilowatt hour, which includes total cost of production and depreciation on the plant, but excludes interest on the investment and profit, assuming that a good quality of bituminous coal can be had for $2.50 per ton. In larger stations with cheaper fuel the cost can be brought to 3½ cents.

Hot Blast and Furnace Irregularities.

Sir Lowthian Bell, in his contribution to the proceedings of the recent meeting of the Iron and Steel Institute, made the following rather remarkable admissions—remarkable in that he was not so long ago a very positive expounder of the superlative merits of iron stoves :

At this point I should like to offer a few remarks upon the question of superheated air. This at the Clarence Works is obtained by means of Cowper's firebrick stoves, which perform their duty in a perfectly satisfactory manner, so far as heating the blast is concerned. I wish it, however, to be understood that it is very rarely indeed that anything under 20 units of coke has sufficed for producing a similar weight of pig iron. I go further and declare that it is exceptional—at any rate, in my own works—when anything less than 21 cwt. covers the consumption of fuel containing 8 per cent. of ash. On one point I believe furnace managers are unanimous—viz., that the use of superheated air is attended with greater irregularity in point of quality of iron, and consequently in consumption of coke, than was the case when metal stoves were universally employed. Among this class of officers this want of uniformity in the blast temperatures is inseparable from the nature of brick stoves, and this comes in for the chief share of the blame for irregular working. My own experience, gathered from the daily performance of 26 furnaces—one half using Cleveland stone and the other half Lancashire hematite—confirms the opinions of the managers at the two places as regards the existence of the irregularity referred to. So far as my own observation goes, those opinions are occasionally founded on the difficulty of discovering any other cause with which they can connect the evil. This is a mode of reasoning fraught with much inconvenience, and often with much loss, because the adoption of an error under such circumstances too frequently leads to no further attempt being made to discover the true cause.

At the same time, I do not pretend to deny that when a furnace receives its blast from a freshly heated stove the temperature of the combustion must rise in some proportion or another. The question, however, is whether this happens to an appreciable, or at all events, to a dangerous extent.

Sir Lowthian Bell figures that the difference between the first and the last minute is only 4.20 per cent., and this is spread over a period of two hours.

He continues : Supposing for the sake of argument that a corresponding fall in the temperature of the hearth had taken place at the end of the two hours when a change of stoves is made. We have at once an influx of hotter air, producing by the carbon it burns 8,556 calories in the first minute, which, it seems to me, would make good the deficiency of 345 calories imagined to have been possible. Besides admitting some slight variation, I am not aware that any one has noticed by the character of the slag that any real inconvenience has resulted from the change in the temperature of the blast.

Although it was not considered probable that any effect would be felt in the temperature of the escaping gases by the sudden alteration of the blast from its lowest to its highest point, special trials were made to determine this question.

Immediately after a charge is introduced a steady increase in the heat of the gases goes on after the previous instantaneous cooling effect produced by their passage through the recently introduced cold minerals. Twenty observations, extending over as many minutes, of the temperatures of the blast and that of the gases were taken simultaneously at intervals of one minute, during which no fresh materials were introduced. The results are recorded below.

The blast, the stove being ready for changing, stood at 1,151° F., and fell to 1,123° at the end of the ninth minute. The escaping gases had a temperature at the beginning of 598° F., which rose to 642° F., being an increase of 44° F. The stove was changed during the tenth minute. In four minutes it rose to 1,401° F., at which it remained as long as the observation lasted. The gases at the end of the tenth minute exhibited no abnormal rise, the increase of temperature over the 10 minutes being 41° F.

A second trial under similar conditions to that just given was made. During the first and second 10 minutes the rise in the temperature of the gases was the same—viz., 45° F. At the end of the tenth minute the blast stood at 1,113° F., and the gases at 650° F. In a very brief space of time after changing the stove the blast rose to 1,400° F., at which it continued to the end of the trial, while the gases had risen to 690° F., or 40° F.

A third trial was made, which also pointed to the fact that the admission of the hotter blast was not accompanied by any marked rise in the temperatures of the gases beyond that previous to such admission.

There is another fact upon which furnace owners as well as furnace managers are in accord—viz., a disposition of furnaces using superheated air to "hang," as it is termed. This, as we well know, is due to the accumulations of the materials when in a plastic condition, causing the mass to adhere to the sides of the interior, and this occasionally increases to such an extent as to form narrow channels through which the heating and reducing gases rush with such velocity as to interfere very seriously, and for the furnace itself very dangerously, with its operations. I know of an instance in which a dome was formed right across the bosh, the summit of which was 27 feet from the hearth. When in the end the furnace had to be blown out it was found, from about the center of this vault, that a chimneylike opening proceeded, traversing the semi-solid growth of the accumulated mineral matter. Its internal surface was rough, thereby further retarding the descent of the materials, all of which had to pass down this tube with a diameter varying from 7 to 10 feet, and about 32 feet in height, and ending at the top in a funnel 11 feet deep and 28 feet in diameter.

I do not say that such an occurrence was quite unknown when blast of 800° to 1,000° F. was in use, but I have little doubt that the difficulty has increased many hundredfold in the few years that firebrick stoves have been in use at the Clarence Works. Instead, therefore, of the very small variations of temperature due to the fluctuations of 100° C. or thereabouts in the blast being the direct cause of irregular working, it is, in my own opinion, much more likely to arise from a general and persistent increase of temperature over an extended area above the tuyeres, due to the use of superheated air, which favors the formation of such a growth as that just described.

In order to exhibit the nature of the irregularities referred to, I have examined the workings of eight furnaces taken over a period of three months ending July 14, 1894. I have in each case taken three weeks in which the average consumption of fuel was at its highest, and a similar period when at its lowest. Placed in the order of the differences, the following numbers show the increased rate of fuel consumed between the two periods of three weeks each : 0.75, 1.11, 1.76, 1.85, 2.25, 2.48,

4.82, 5.47 cwt. per ton of iron. It ought to be added, so far as my own observation goes, and I have heard it confirmed in other quarters, the tendency complained of seems to increase with the age of the furnace.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Something about the Recent Proposed Opposition for St. Paul, Minn.

ST. PAUL, MINN., September 13, 1894.

To the Editor AMERICAN GAS LIGHT JOURNAL: In the early part of July rumor reached the inhabitants of this city that the dawn of the millennium was approaching, bringing in its train, not the total destruction of the people, simply that of the price of gas, both as an illuminant and for cooking and power.

A gentleman styled Colonel R. H. Pugh then came to the city, and employed several persons to canvass the city and suburbs for would be consumers for the proposed new Gas Company, as also signers to a petition to the Council of the city requesting that body to grant the prayer of the said Pugh, thus enabling them (the signers) to shake off the thraldom of the St. Paul Gas Light Company, under which, according to Mr. Pugh, they had so long suffered. Perhaps it would be well to say at this point that the suffering above mentioned had been borne so stoically that no hint of the oppression, or remonstrance against it, had ever reached the ears of the officers of the Gas Company.

The petition was duly presented to the City Council, asking that an ordinance be passed granting to the said Col. R. H. Pugh, his successors or assigns, a franchise to erect and maintain a works for the manufacture of gas and to lay mains in the streets, lanes and alleys of the city, for the purpose of distributing the same to its consumers. The ordinance fixing the price of gas at $1.30 (gross) per 1,000 cubic feet, with a discount for prompt payment, that would make the net cost of gas for illuminating purpose $1.10 per 1,000 cubic feet, and 90 cents per 1,000 cubic feet for other purposes. A further provision agreed to either give the city a controlling interest in the stock of the Company, or pay into the city treasury 5 per cent. of the amount of the gas receipts of the proposed Company; and it was further agreed to lay five miles of main within one year from the adoption of the ordinance. This is the pith and substance of the franchise asked for. Attached to the proposal to pay the percentage of gross receipts was attached a very large string, to the effect that if at any time the price for gas should fall below the figures given in the franchise, then no benefit or interest would accrue to the city. The matter was referred to the Committee on Gas, for investigation, the President of the Council being added to the Committee.

Before following the ordinance to the Committee, I propose to outline what rumor had were the ideas and plans of the said Col. R. H. Pugh, his successor or assigns—so far as they were given out. It must be stated that whilst Col. Pugh was canvassing this city he also had likewise a force of canvassers at work in Minneapolis, his intention being to apply for a franchise for that city also. It was proposed by the parties in question to establish a large plant, on the dividing line of the counties of Hennepin and Ramsey, and from that plant to supply both cities. The proposed location is certainly central, but far from desirable so far as St. Paul was intended, being about 150 feet higher than the average level of that city. With the exception of the suburban towns of Merriam Park, Hamline, St. Anthony's Park, and one or two others, it would have required at least five miles of main to be laid before any consumers could be reached. Now, as to what could be expected in the way of business from the places named, I need only state that, having been urgently petitioned by the inhabitants of Merriam Park, the St. Paul Gas Company extended its mains to and throughout that place, necessitating the putting down of 12 miles of main, from 16 inches to 4 inches in size, and for its reward the Company has secured about 40 consumers, and not a single public gas lamp on the line; in fact, that Company has miles upon miles of main laid down for the accommodation of its consumers, upon which no city lamps are maintained and the revenue from which does not pay the interest on the cost of the work, to say nothing of the gas consumed.

It was in the outlying districts that the canvassers of the Company labored hard and there secured a very large portion of the signers, as also in districts almost entirely populated by the laboring classes, who readily signed when informed that the construction of the new works would provide labor for thousands of men for an indefinite period of time. A review of its consumers' names and residences shows places and a class that the proposed new Gas Company never intended to reach; nor did the petitioners expect or desire them to. Of course, a respectable number were already gas consumers, and ready to jump at any offer that would seemingly reduce expenses. This brings the matter up to the time of the meeting of the Committee, which was held last month, and the petition handed in by the Company's attorney presented a medley of figures clipped from various newspapers, census reports, etc., all of which could be said to have for their base the report of Prof. Bemis, of the Chicago University, showing the cost of gas in other cities, but at no time so leveling the cost of material and maintenance that a true and proper comparison of cost of manufacture and maintenance could be had. In fact, the plea of their attorney seemed to give a voluminous amount of statistics that read well, sounded like cheap gas for St. Paul, but at the same time care was taken to say nothing upon which anyone could hang a thread of impression or positive information. They refused or could not reply to the query as to when they proposed to erect their plant, notwithstanding the current report I have quoted of its proposed location.

They wanted 90 days in which to put up security to indemnify the city against loss, in case of a decision in favor of the validity of the exclusive franchise of the St. Paul Gas Company, which suit they were advised would at once be laid upon the granting of the franchise. They refused to give the names of any of the backers of Col. Pugh, beyond naming Mr. H. C. Rew, of Chicago, and some indefinite English relations of the Colonel's, who were nameless. Their supreme effort was put forth to show that if the St. Paul Gas Company had not to pay interest on so many bonds they could sell gas for less than $1 per 1,000 cubic feet. For my part I cannot see how they were to be any better off, for they certainly proposed to build their plant from the proceeds of the sales of bonds, and not upon capital stock paid in, otherwise how were they to fulfill their agreement with the city to give them a controlling interest of the stock? So that by the time they had acquired the same amount of property and mileage of mains, etc., owned by the present Company, their output of bonds would be greater than that of the St. Paul Gas Company. They endeavored also to bring in a few remains from the Minneapolis arbitration, but did it in such bungling manner that Mr. H. Brown, President of the Minneapolis Company, refuted every statement made. The statements made by them regarding the amount of business done and bonds issued by the St. Paul Gas Company were erroneous in every particular, and they were so informed by Mr. Livingston in the presence of the Committee.

The St. Paul Gas Company denied in rebuttal that it was acting under an exclusive charter, granted by the Legislature of the Territory of Minnesota in 1856, and which did not expire until the year 1907; that since Minnesota had been admitted as a State, all Acts passed by her Legislature that in any way related to the matter of the manufacture of gas, etc., specifically stated that it could have no effect as against the St. Paul Gas Company; decisions were quoted on similar cases showing that the charter would be sustained by the Supreme Court of the United States; and that as the Gas Company's bonds and stock were very largely held by the people of Minnesota, the granting of the franchise would hurt the business of the Company and thus work an injury to residents of the State. The Company also showed that the price of gas had been reduced from $7.50 per 1,000 cubic feet to $2 per 1,000 cubic feet, the latter price carrying discounts of from 5 to 25 per cent. for prompt payment, and that prior to the coming of Col. Pugh and his attendants the Company had declared a reduction to $1.50 per 1,000 to all consumers, to take effect September 1st.

The Company also showed that with the differences of cost of materials used in manufacture brought to a level with the cities quoted by Col. Pugh's attorney, and a proper allowance made for extra cost for distribution (the result of climatic influences), that the price of gas was equally low with any city having the same amount of annual output.

The statements which I have so briefly outlined necessitated four meetings of the Committee, who finally submitted the following report to the Council:

To the Honorable, the Board of Aldermen, of the City of St. Paul—Gentlemen: Your Committee having under consideration File No. 3563, being entitled "An ordinance granting to R. H. Pugh the right to lay gas pipes in the streets, and to manufacture and sell gas in the city of St. Paul," respectfully report to your honorable body as follows:

Your Committee has held four public sittings, upon the 24th, 25th and 27th days of August, at all of which it gave to all persons desiring to be heard upon this proposed ordinance, including R. H. Pugh and his legal representative and the St. Paul Gas Light Company and its attorney, ample opportunity to express themselves upon all phases of the question under consideration. Indeed the statements and discussions before your Committee took a very wide range and touched many

questions connected with the manufacture of gas and the cost of constructing gas plants which were not necessarily connected with or even pertinent to the application under consideration. Your Committee offered to receive any evidence that any person might desire to offer upon the subject. Mr. Pugh's attorney, however, contented himself with an argument and citation of statistics from general statistical works and newspapers, articles upon the subject of the cost of manufacture of gas and of the construction of gas plants, and even from W. T. Stead's work "If Christ Came to Chicago," none of which had any special or necessary application to local conditions. The Gas Company, in reply, quoted from similar works, and the various officers also made a number of specific statements as to conditions existing in St. Paul, which were not denied by Mr. Pugh or his attorney. The whole effort of Mr. Pugh seemed to be directed to show that gas could in general be manufactured and supplied at the prices named in the proposed ordinance, and that the St. Paul Gas Light Company, by reason of alleged excessive capitalization, could not put the prices down to as low a figure as those proposed by Mr. Pugh. The effort of the Gas Company was to rebut these propositions of Mr. Pugh, to demonstrate its own rights in the premises, to show the unwisdom of the ordinance proposed, to suggest the various losses that might result to the city if it or any similar one were passed, to show that it was selling gas at as low or at a lower price than the average price charged by other gas companies throughout the country, and to criticise the standing and motives of Mr. Pugh and his associates.

Your Committee, knowing that the St. Paul Gas Light Company is a local concern, and that the larger share of its bonds, as well as most of its stock, is held by citizens of St. Paul, and knowing, as practical business men, that the passage of the ordinance would injure the credit of that Company and depreciate the value of its stock and bonds, rendering them, for the time at least, valueless as collateral, felt from the beginning that the burden of showing that the passage of the proposed ordinance would result in a substantial and permanent benefit to our city, considered from all points of view—should rest upon Mr. Pugh.

The first subjects of investigation by your Committee were the financial standing of Mr. Pugh and his backers, and the good or bad faith in which his proposition was made. Mr. Pugh's attorney, at the outset, frankly acknowledged that Mr. Pugh himself had no financial standing, but claims that he had come here as the agent of one Henry C. Rew, of Chicago, who, it is claimed, is a reputable man. Your Committee, while it had no other evidence that Mr. Rew is behind Mr. Pugh in this matter, has conceded such to be the fact. No names of other backers of Mr. Pugh were furnished your Committee, although repeatedly asked for. The St. Paul Gas Light Company claimed at the outset of the investigation that in case the Council of this city, knowing the provisions of that Company's charter, as to exclusive right to use the streets, deliberately granted to another person the right to lay gas pipes in our streets, and the city's grantee attempted to do so, that Company could recover from the city damages for any actual injury it could prove to have resulted from such action. To cover this point, and to secure the city from damage in the tearing up of pavements, etc., as well as to secure evidence of good faith upon the part of Mr. Pugh, the Committee asked for a statement of the amount and character of the securities he would deposit to secure the city against loss and would forfeit in case of non-performance of the provisions of this ordinance upon his part. Mr. Pugh said in reply that he was unable to make such a statement, although professing to be able to satisfy the Committee in that regard. He offered, in case the Council would pass the ordinance, either to make a satisfactory statement and proposition as to security in thirty days or to resign all rights under the ordinance.

Your Committee could not regard this as a satisfactory answer to a simple inquiry that Mr. Pugh should have been prepared to answer at once, particularly as Mr. Pugh had already had some 30 to 40 days' notice that your Committee would require such a statement from him. This incident, and other circumstances as well, reflect unfavorably upon the animus of Mr. Pugh's proposition, which, however, may be proper. It should be said that in reaching its conclusion your Committee has accepted as substantially true the statements made by both parties to the controversy. These statements do not conflict in any important particular.

After the hearing above detailed, and full consideration of all statements and arguments made, your Committee is unable to recommend the passage of the ordinance under consideration, for the following reasons:

First.—The ordinance itself contains so little in the way of promise of substantial benefits to the city that it would not, even if amended in its details—which are uniformly faulty—be anything like an adequate return for the important concessions asked. When it is boiled down, substantially all Mr. Pugh agrees to do is to lay five miles of mains somewhere in the city, and to build works sufficient to supply these mains, and to supply gas from them at the prices named. When it is known that the present Gas Company operates, in addition to its electrical and heating business, 115 miles of gas mains, the insignificance of Mr. Pugh's proposition is apparent.

Second.—Mr. Pugh cannot or will not state where in the city his proposed works would be located or where his five miles of mains would be laid, both of which things should be known before any ordinance should be passed. He stated that the system he should employ would be that used at Mr. Rew's works at Cicero, Ill., but offered no statement as to the character or capabilities of that system. It may be stated in passing that it was admitted by Mr. Pugh that the price of gas at Cicero, Ill., where that system is in use, is $1.50 per 1,000 cubic feet.

Third.—Mr. Pugh could not or would not state who his backers were, except Mr. Rew (who binds himself to nothing), and could not or would not satisfy your Committee as to what security he would offer the city as a pledge of good faith and to indemnify it, contenting himself with general statements, too easily made and repudiated.

Fourth.—The St. Paul Gas Light Company claims the exclusive right to use the streets for gas mains. It is conceded upon all hands, and by the City Attorney, that if this ordinance were passed the litigation that would ensue would, under the terms of the ordinance, prevent any work being done under it for four years, and perhaps for a much longer period, even if the ordinance were at length held valid. Your Committee is of the opinion that it would not be wise for the city to grant a franchise which could not take effect for four or five years, especially when it has the right to purchase the plant of the present Gas Company at an appraised valuation January 1, 1897.

Fifth.—It does not seem to your Committee that Mr. Pugh has sufficiently considered the local conditions in formulating his proposition as to prices, and it seems more than doubtful whether he could furnish gas at the prices named under the peculiar conditions of transportation and climate that obtain in St. Paul. For instance, it appears that during the winter of 1893–4 the St. Paul Gas Light Company spent something over $10,000 in thawing and repairing pipes and mains injured by frost and freezing, and suffered leakage on the same account amounting to more than 26,000,000 cubic feet; also that gas coal costs about $2 per ton more in St. Paul than in any of the places cited by Mr. Pugh's attorney.

Sixth.—There appears to be no general dissatisfaction among our people with the present conduct of the business of the St. Paul Gas Light Company. That Company has recently made large reductions in its prices which affect about 90 per cent. of the gas consumers of the city, and promises to make further reductions if those made result in even approximately proportional increases in consumption. It is worthy of notice that no citizens, or committees representing citizens, appeared before your Committee to urge the passage of the proposed ordinance.

Seventh.—The prices at present charged in this city seem as low as, and in many instances lower than, the prices charged in other cities (generally speaking), even if no allowance be made for differences in conditions.

Eighth.—The St. Paul Gas Light Company is owned and its bonds are largely held by our citizens, who should not be wantonly injured, as injury to them means injury to the whole city, or unless there be some plain and equal benefit to be obtained as a result.

Ninth.—Competing gas companies do not mean cheaper gas. The history of the business is that after a short period of competition a division of territory or consolidation results, and the price of gas is increased to cover the cost of the gas war; also that thereafter prices are kept higher than they otherwise would have been, on account of the increased investment and increased interest charges. It is conceded that there are not to-day two gas companies on the same street anywhere in the world, doing a competing business.

Tenth.—The city now has the right, Jan. 1, 1897—a little more than two years hence—to purchase the entire plant of the St. Paul Gas Light Company at an appraised valuation. If another gas franchise were granted, the value of this valuable right of purchase would then be destroyed, as it would then be necessary, in order to make the right effective, to purchase both plants, or the duplicated plant, if consolidation had occurred. Your Committee is of the opinion that to destroy this right of purchase would be wholly inexcusable.

In this connection your Committee represents that the President and attorney for the St. Paul Gas Light Company made the following statement to the Committee, which was apparently made in good faith, and

is certainly worthy of careful consideration before any proposition to permit rival works is to be considered :

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"*Resolved*, further, that we favor the purchase of the plant of the present Company when the opportunity arrives in the near future, as provided for in the charter of the Company, the Assembly being positively in favor of the municipal ownership of gas and electric light plants."

We are indebted to Messrs. Wait & Clarke, of Boston, for the following: "The annual election of officers of the Jamaica Plain (Mass.) Gas Company, which was held on the 17th inst., resulted in the overturn of the old management in favor of a directorate of which the majority represents the controlling power of the Brookline Gas Company. The stockholders' meeting, which was twice adjourned for the purpose of gaining time and strength by the Brookline element, was held at the office of the Jamaica Plain Company, President F. S. Pratt in the Chair. The number of shares represented was 2,364, out of a total of 2,500, and of these 1,304 shares chose Messrs. Eugene N. Foss, Albert C. Burrage, Edwin A. Hildreth, Fred. Seaver and Chas. D. Burrage for Directors, against 1,060 shares voting for Messrs. F. S. Pratt, N. J. Rusk, Aretas Blood, C. F. Curtis and A. B. Heath. The victorious ticket had in Messrs. Foss and the Burrage brothers men prominently identified with the Brookline Gas Company, Mr. Albert C. Burrage holding for the past two years the position of its Counsel. The power of the Brookline management was immediately shown when, at the meeting of the newly elected Board, after the adjournment of the stockholders' meeting, Mr. Foss was chosen President and Mr. Albert C. Burrage Clerk and Treasurer of the new regime. Messrs. Seaver and Hildreth were members of the old Board. There was no friction at either meeting, the minorities of both stockholders and new Directors acquiescing with as much grace as possible in what they saw was inevitable. This contest began about six months ago, when Mr. A. C. Burrage acquired a block of the Company's stock. Together with President Foss, who was a Director in the Company, but favorable to a change of management, he secured 1,255 of the 2,500 shares. As the date of the annual election approached the Directors became aware of their danger and tried to avert the impending change, but had to succumb. Mr. A. C. Burrage, when spoken to about the generally believed fact that the Jamaica Plain Company had been absorbed by the Brookline Company, said: 'This purchase was not made for the purpose of engaging in any consolidation scheme. I understand that certain parties interested in the Bay State Gas Company have, during the past few days, made a strong effort to prevent the control passing into our hands. What their purpose was I cannot, of course, say, but I can state that if their purpose was to turn the Company over to the Bay State Gas Company, or to make any alliance with it, they cannot accomplish their purpose. The plant is a most valuable one. It covers a large territory, and it certainly is not the intention of the new management to give any less satisfaction in the future than the Company has given in the past.' Mr. Burrage further said there was no intention on the part of the new directorate to change anything in the present order of business. Brookline gas would not be served for the present. The Brookline Company, as a Company, had not one dollar in the Jamaica Company. Asked as to the eventual issue of the gas agitation in Boston, he would not say that there would be a final consolidation of all Companies, and he emphatically repeated his statement that there was no coalition contemplated with the Bay State Gas Company."

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"*Resolved*, That the Assembly protests against the granting by the Council of any new franchises for lighting the city; and

"*Resolved*, further, that we favor the purchase of the plant of the present Company when the opportunity arrives in the near future, as provided for in the charter of the Company, the Assembly being positively in favor of the municipal ownership of gas and electric light plants."

We are indebted to Messrs. Wait & Clarke, of Boston, for the following: "The annual election of officers of the Jamaica Plain (Mass.) Gas Company, which was held on the 17th inst., resulted in the overturn of the old management in favor of a directorate of which the majority represents the controlling power of the Brookline Gas Company. The stockholders' meeting, which was twice adjourned for the purpose of gaining time and strength by the Brookline element, was held at the office of the Jamaica Plain Company, President F. S. Pratt in the Chair. The number of shares represented was 2,364, out of a total of 2,500, and of these 1,304 shares chose Messrs. Eugene N. Foss, Albert C. Burrage, Edwin A. Hildreth, Fred. Seaver and Chas. D. Burrage for Directors, against 1,060 shares voting for Messrs. F. S. Pratt, N. J. Rusk, Aretas Blood, C. F. Curtis and A. B. Heath. The victorious ticket had in Messrs. Foss and the Burrage brothers men prominently identified with the Brookline Gas Company, Mr. Albert C. Burrage holding for the past two years the position of its Counsel. The power of the Brookline management was immediately shown when, at the meeting of the newly elected Board, after the adjournment of the stockholders' meeting, Mr. Foss was chosen President and Mr. Albert C. Burrage Clerk and Treasurer of the new regime. Messrs. Seaver and Hildreth were members of the old Board. There was no friction at either meeting, the minorities of both stockholders and new Directors acquiescing with as much grace as possible in what they saw was inevitable. This contest began about six months ago, when Mr. A. C. Burrage acquired a block of the Company's stock. Together with President Foss, who was a Director in the Company, but favorable to a change of management, he secured 1,255 of the 2,500 shares. As the date of the annual election approached the Directors became aware of their danger and tried to avert the impending change, but had to succumb. Mr. A. C. Burrage, when spoken to about the generally believed fact that the Jamaica Plain Company had been absorbed by the Brookline Company, said: 'This purchase was not made for the purpose of engaging in any consolidation scheme. I understand that certain parties interested in the Bay State Gas Company have, during the past few days, made a strong effort to prevent the control passing into our hands. What their purpose was I cannot, of course, say, but I can state that if their purpose was to turn the Company over to the Bay State Gas Company, or to make any alliance with it, they cannot accomplish their purpose. The plant is a most valuable one. It covers a large territory, and it certainly is not the intention of the new management to give any less satisfaction in the future than the Company has given in the past.' Mr. Burrage further said there was no intention on the part of the new directorate to change anything in the present order of business. Brookline gas would not be served for the present. The Brookline Company, as a Company, had not one dollar in the Jamaica Company. Asked as to the eventual issue of the gas agitation in Boston, he would not say that there would be a final consolidation of all Companies, and he emphatically repeated his statement that there was no coalition contemplated with the Bay State Gas Company."

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

MONDAY, SEPTEMBER 24, 1894.

The Market for Gas Securities.

The stereotyped report of "no change for the week" in the values of Consolidated must be again put in evidence, the opening price to-day (Friday) being identical with that of a week ago —bid 123¼, offered at 124¼. These figures, however, are merely nominal, and well-informed holders seem to agree in the opinion that Consolidated is a purchase at anything under 125. Equitable is steady at 170 to 175, and a fair price for Mutual would be 150. New York and East River common is not as "firm" as it was a week ago, the bid price being turned in at 20. Meanwhile the sales are not numerous. Standard is strong, at 79 to 82 for the preferred, but there is a wide margin in the estimate of the value of the common, as between holders and bidders. The quotations are 27 to 35.

The Brooklyn situation is still indeterminate, but the end of the squabble cannot be far away. Chicago gas sold down to 67¼ during the week, but recovered some of the loss. The opening to-day was at 71 to 71¼, and the tone pointed to lower prices before the close of the day's business. This stock is cheap. Bay State was prominent in the dealings, selling up to 26¼, and Baltimore Consolidated is strong, at 67¼, bid.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 Wall St., New York City.

September 24.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	123	124¼
Central	500,000	50	103	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	170	175
" Bonds	1,000,000	—	106	108
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	27	35
Preferred	5,000,000	100	79	82
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	105	—
Citizens	1,200,000	20	—	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	133	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	75	—
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	145	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	155	165
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	150	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	26	26½
Income Bonds	2,000,000	1000	34½	35
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	80	83
2d " " "	3,000,000	1000	59	—
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	160	—
Chicago Gas Company.	25,000,000	100	71	71¼
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	56	60
Bonds	600,000	1000	92	—
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			90	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt	11,000,000	100	67¼	67¾
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
Con. Bonds	.....	.....	—	50
East River Gas Co., Long Island City	1,000,000	100	20	22
Preferred	.....	.....	36	38
Bonds	500,000	100	81	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	19	19¼
Preferred "	2,500,000	100	73	75
Bonds	9,034,400	1000	88¼	—
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
New Haven, Conn		25	200	—
Oakland, Cal			42⅜	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City	500,000	—	175	185
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal	10,000,000	100	71	71½
Washington, D. C	2,000,000	20	240	—
Wilmington, Del.	500,000	50	188	190

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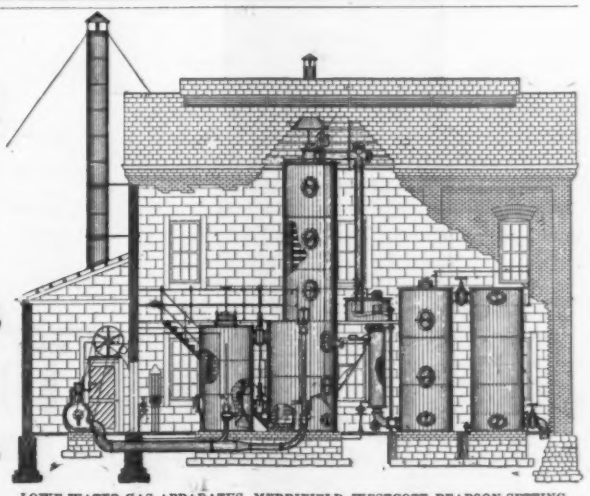

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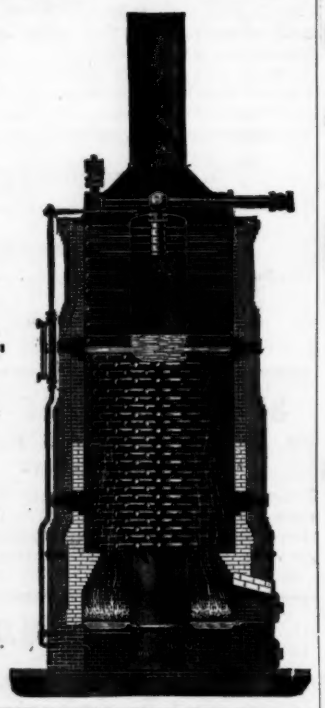

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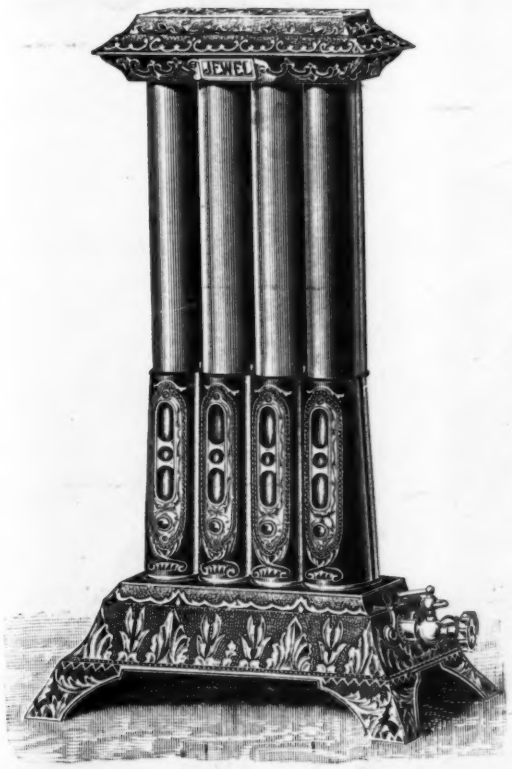

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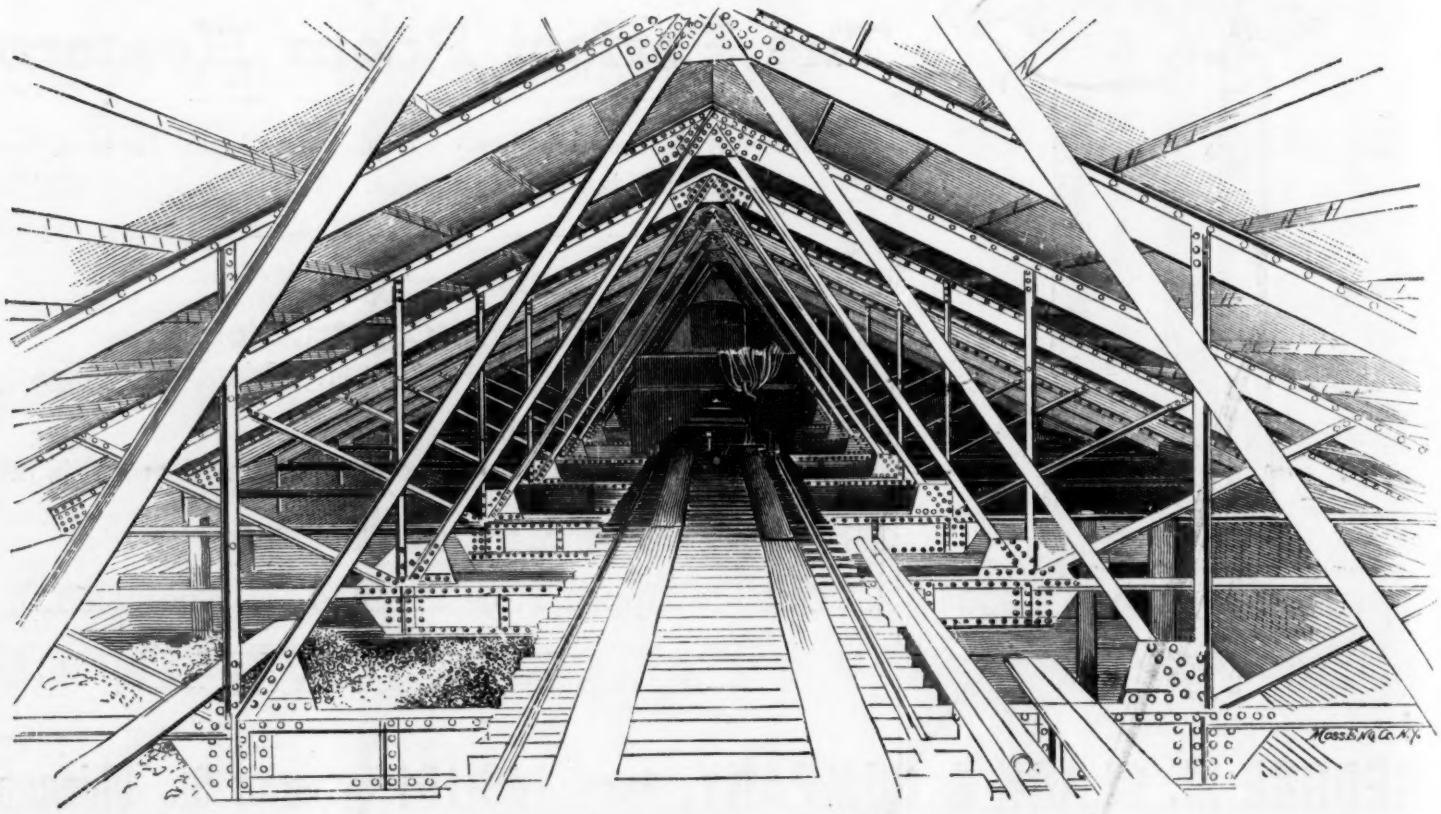

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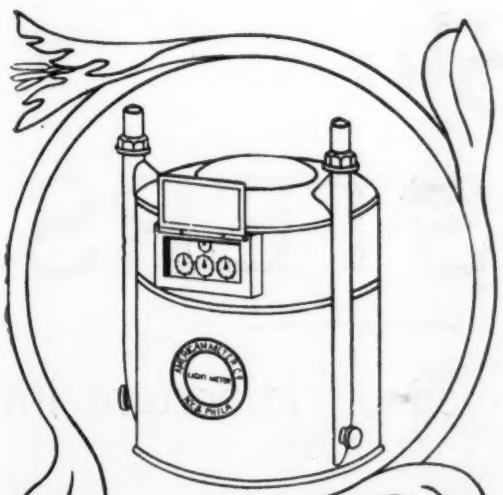

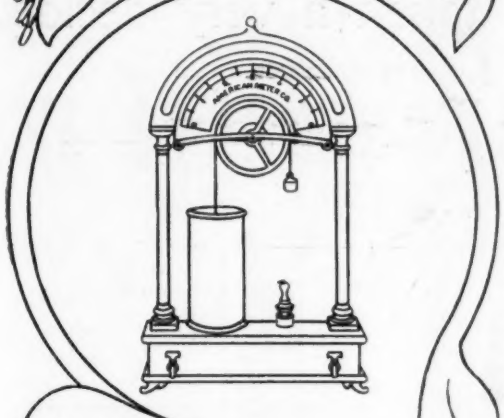

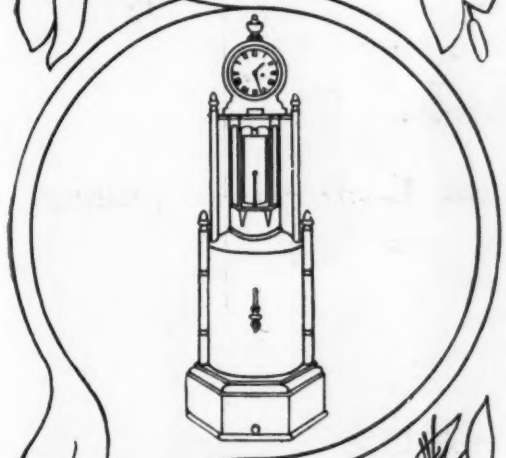

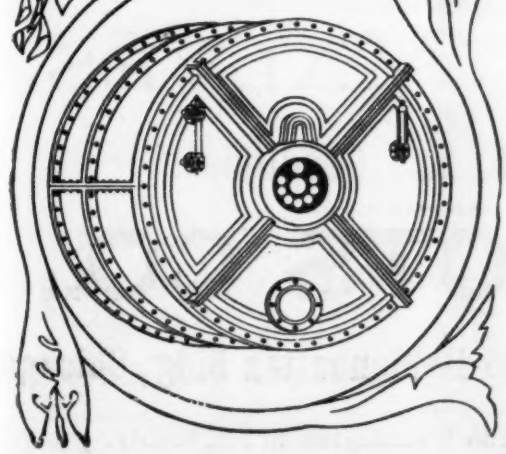

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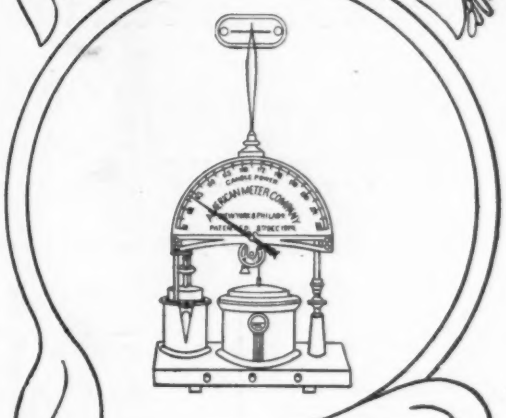
PUBLIC LIGHTING TABLE.

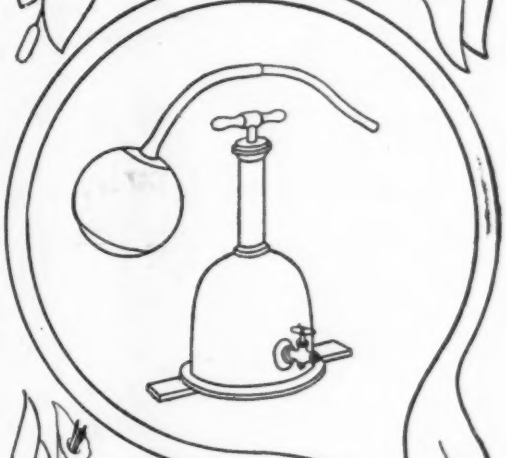
OCTOBER, 1894.

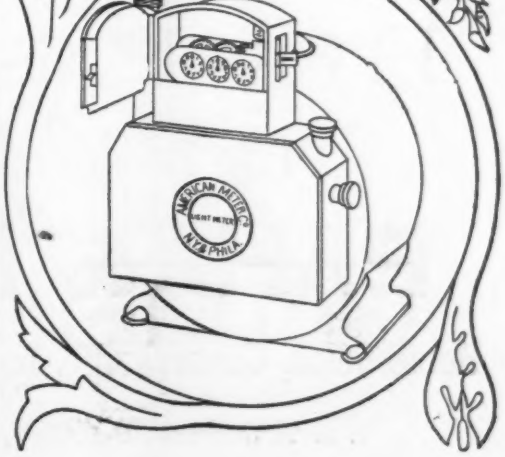
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	6.10 PM	5.00 AM	5.30	5.00
Tue.	2	6.10	5.00	5.30	5.00
Wed.	3	6.10	5.00	5.30	5.00
Thu.	4	7.40	5.00	5.30	5.00
Fri.	5	8.40	5.00	5.30	5.00
Sat.	6	9.30 FQ	5.00	5.30	5.00
Sun.	7	10.30	5.00	5.30	5.00
Mon.	8	11.40	5.00	5.20	5.10
Tue.	9	12.40 AM	5.00	5.20	5.10
Wed.	10	1.40	5.10	5.20	5.10
Thu.	11	2.50	5.10	5.20	5.10
Fri.	12	3.50	5.10	5.20	5.10
Sat.	13	No L.	No L.	5.20	5.10
Sun.	14	No L. FM	No L.	5.20	5.10
Mon.	15	No L.	No L.	5.10	5.20
Tue.	16	5.50 PM	7.10 PM	5.10	5.20
Wed.	17	5.50	7.50	5.10	5.20
Thu.	18	5.50	8.40	5.10	5.20
Fri.	19	5.40	9.40	5.10	5.20
Sat.	20	5.40	10.40	5.10	5.20
Sun.	21	5.40 LQ	12.00	5.10	5.20
Mon.	22	5.40	1.20 AM	5.00	5.30
Tue.	23	5.40	2.30	5.00	5.30
Wed.	24	5.40	3.40	5.00	5.30
Thu.	25	5.40	5.20	5.00	5.30
Fri.	26	5.30	5.20	5.00	5.30
Sat.	27	5.30	5.20	5.00	5.30
Sun.	28	5.30 NM	5.30	5.00	5.30
Mon.	29	5.30	5.30	4.45	5.35
Tue.	30	5.30	5.30	4.45	5.35
Wed.	31	5.30	5.30	4.45	5.35

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45







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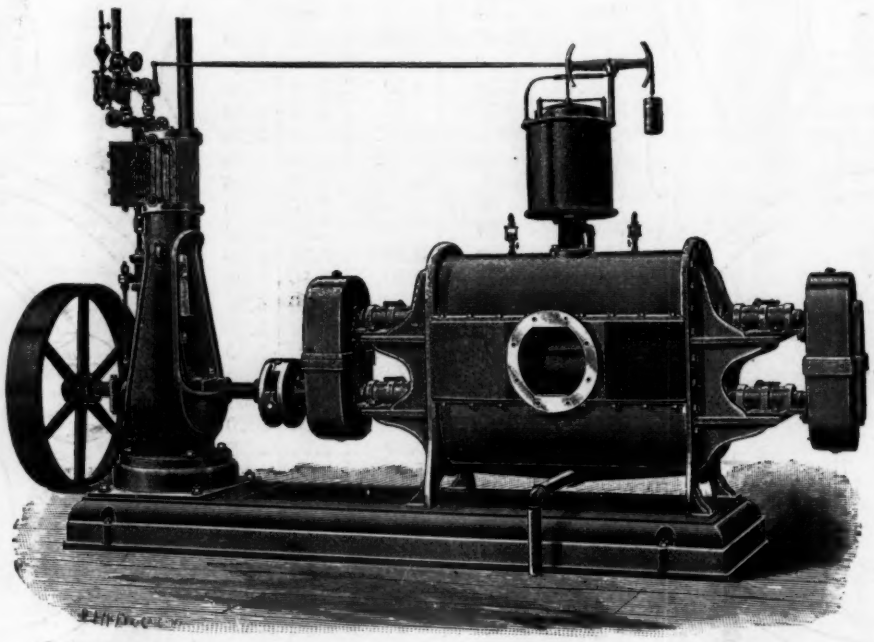

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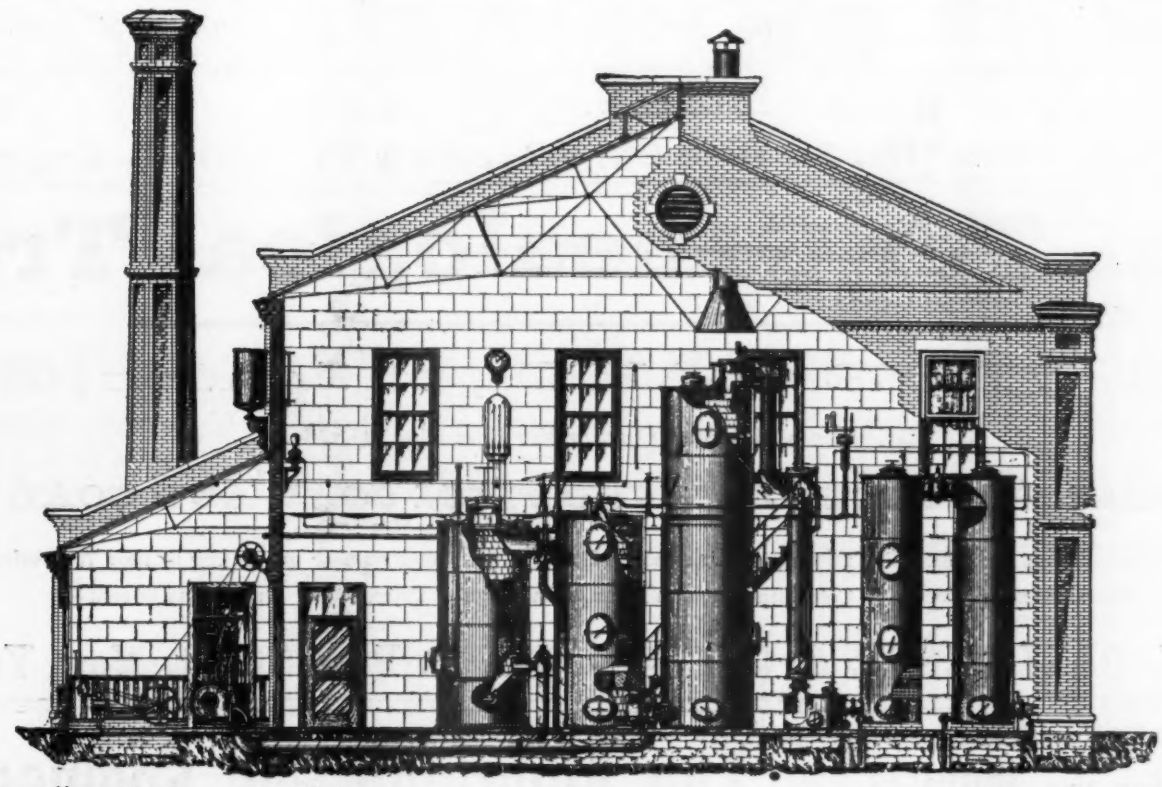

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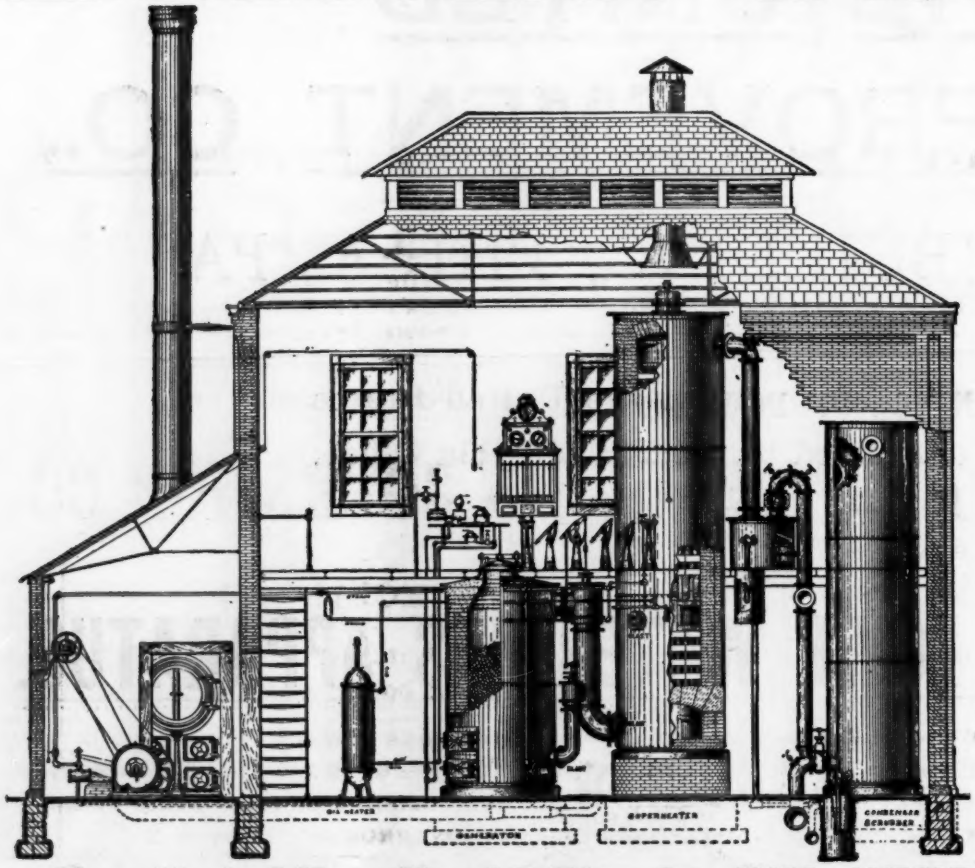

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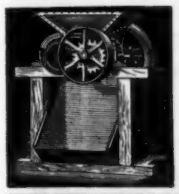

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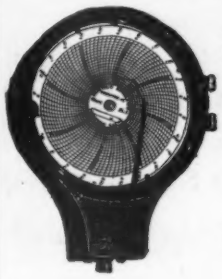

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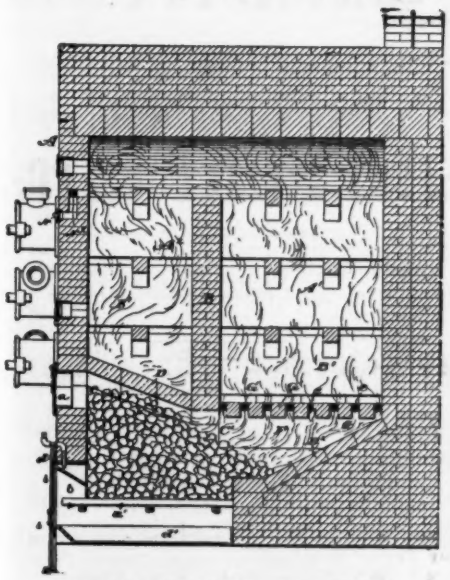

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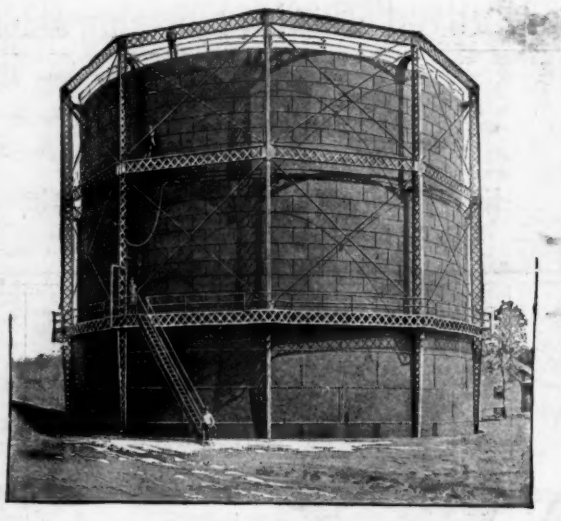

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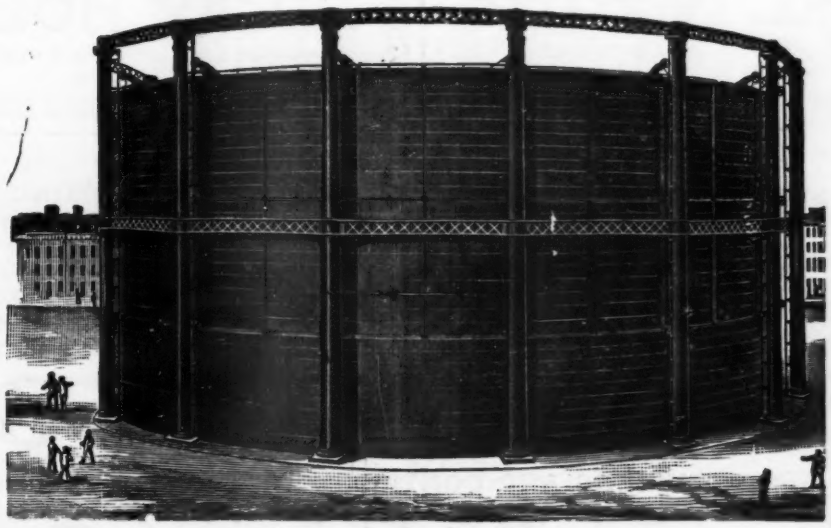

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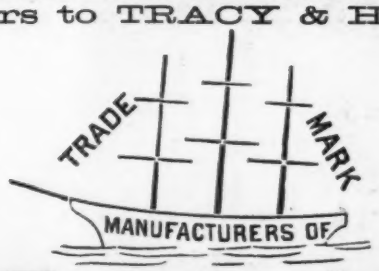

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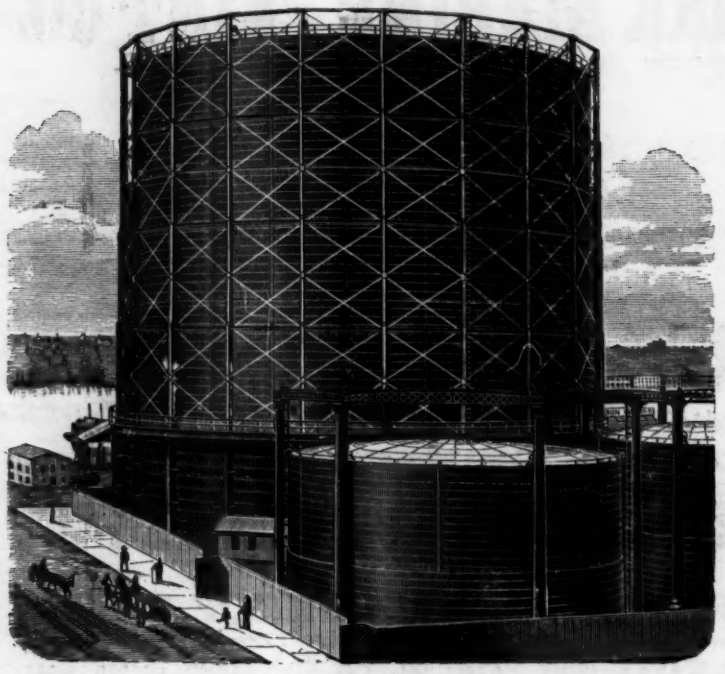

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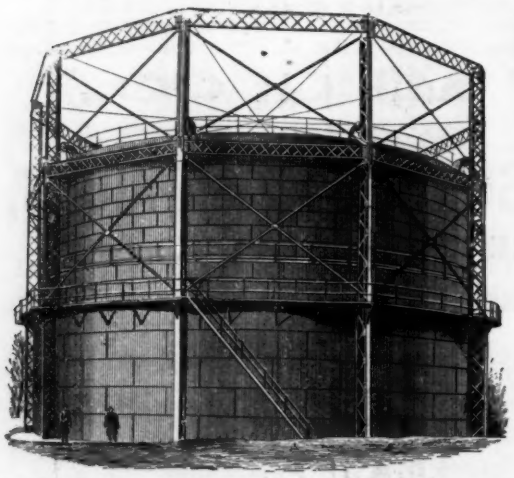

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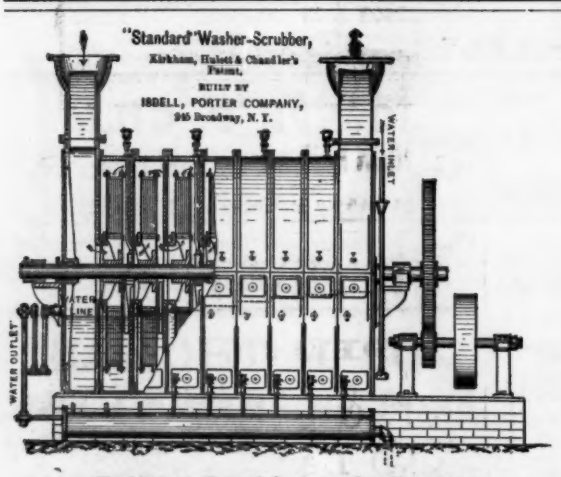

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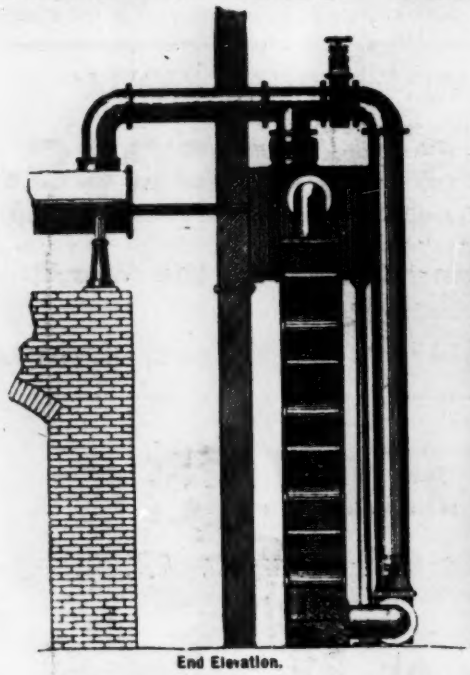
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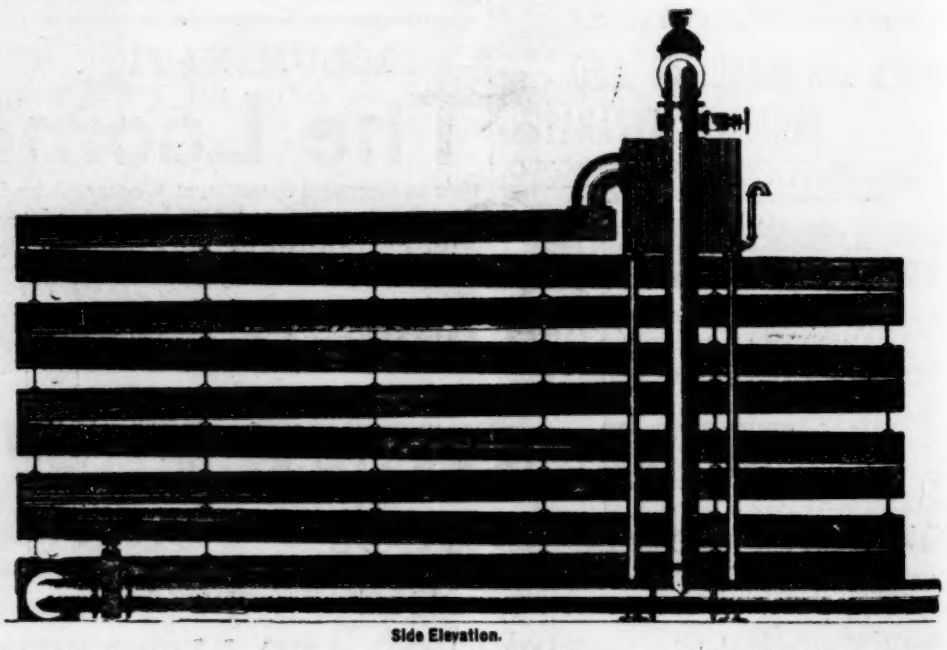
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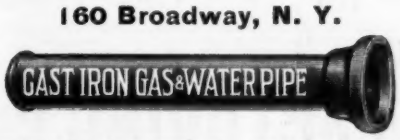

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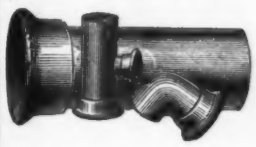

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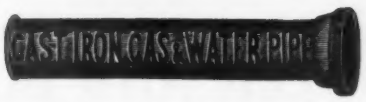

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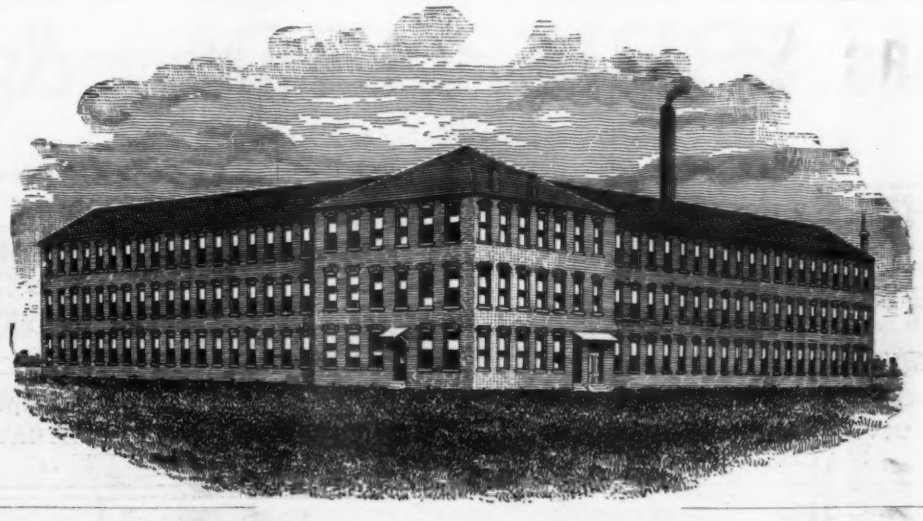

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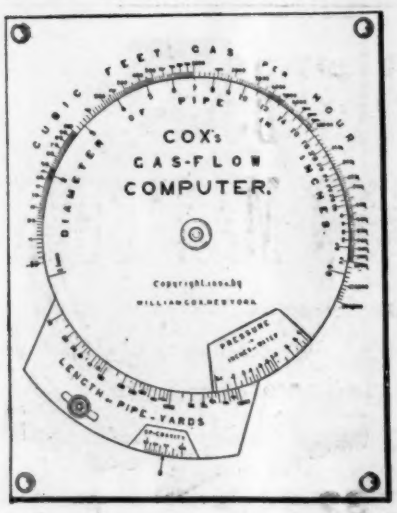

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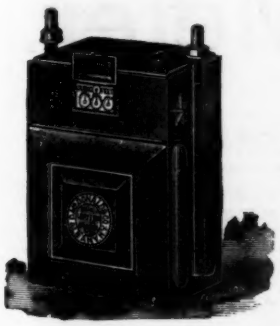

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